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APPENDIX B
MAP FOLDOUTS

APPENDIX C
GLOSSARY & BIBLIOGRAPHY

APPENDIX D
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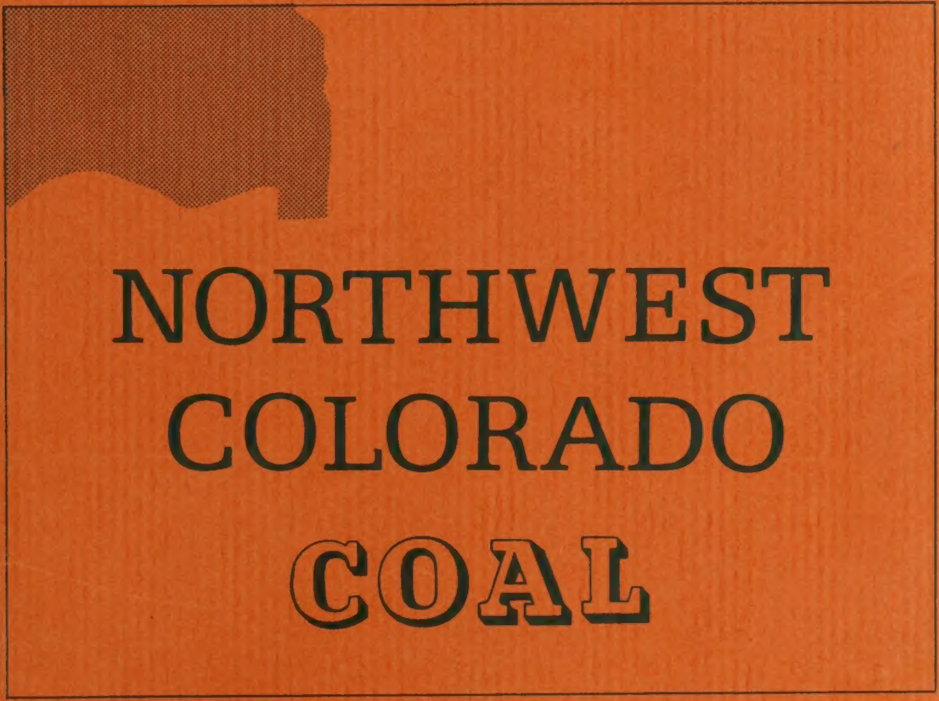
ENVIRONMENTAL STATEMENT



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APPENDIX B

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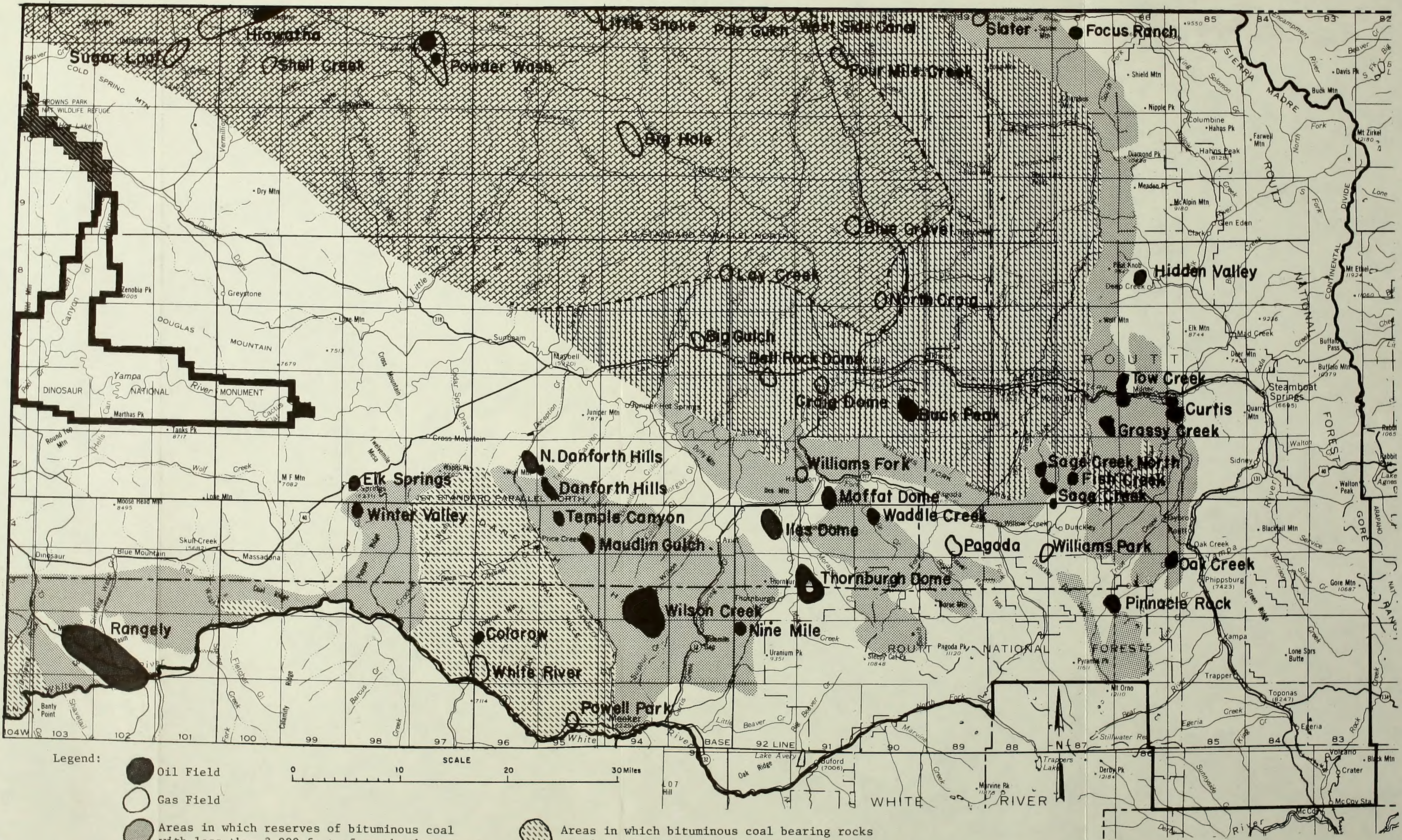


Legend:

● Oil Field

○ Gas Field

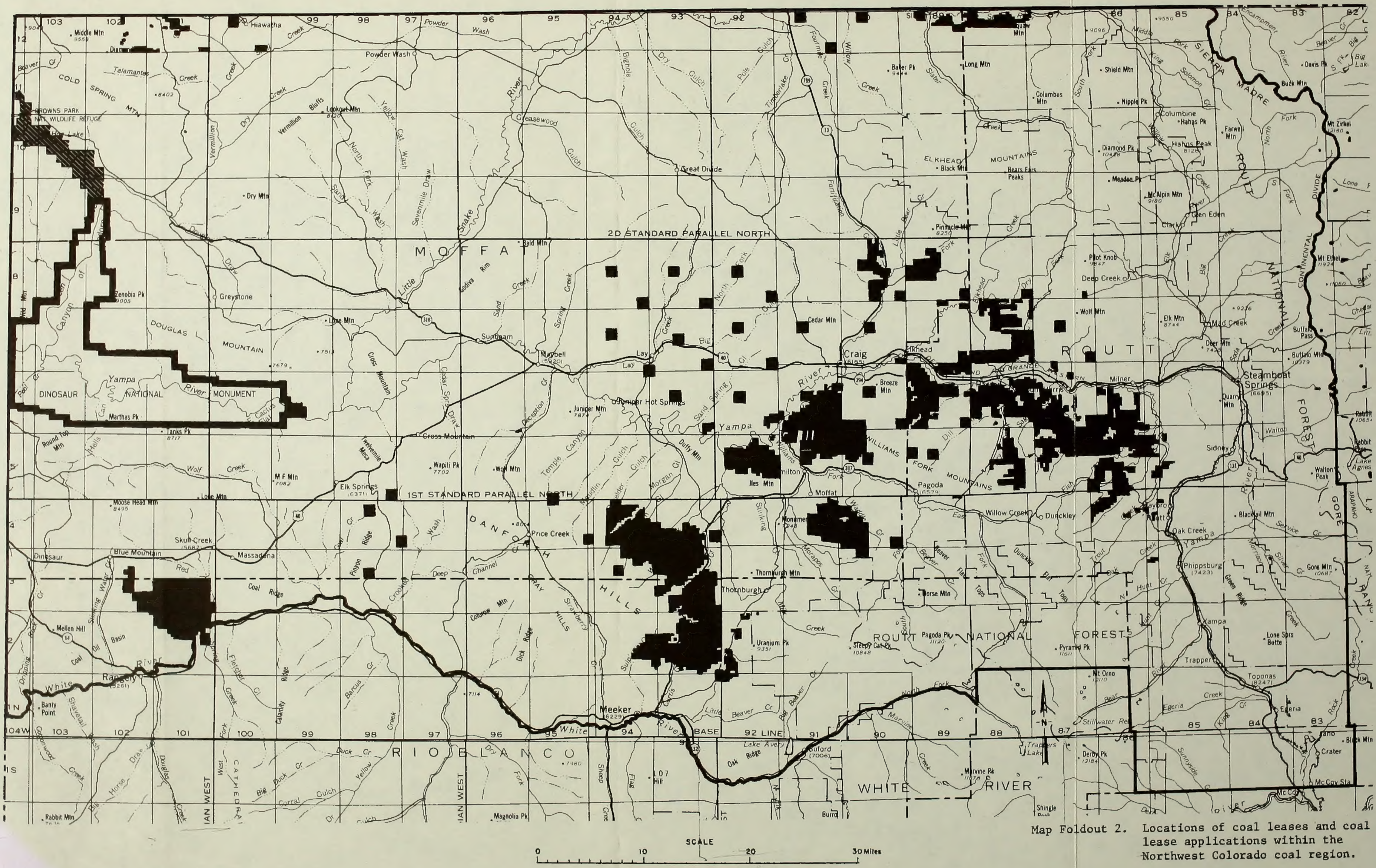
▨ Areas in which reserves of bituminous coal with less than 3,000 feet of overburden occurs

▨ Areas in which reserves of subbituminous coal with less than 3,000 feet of overburden occurs

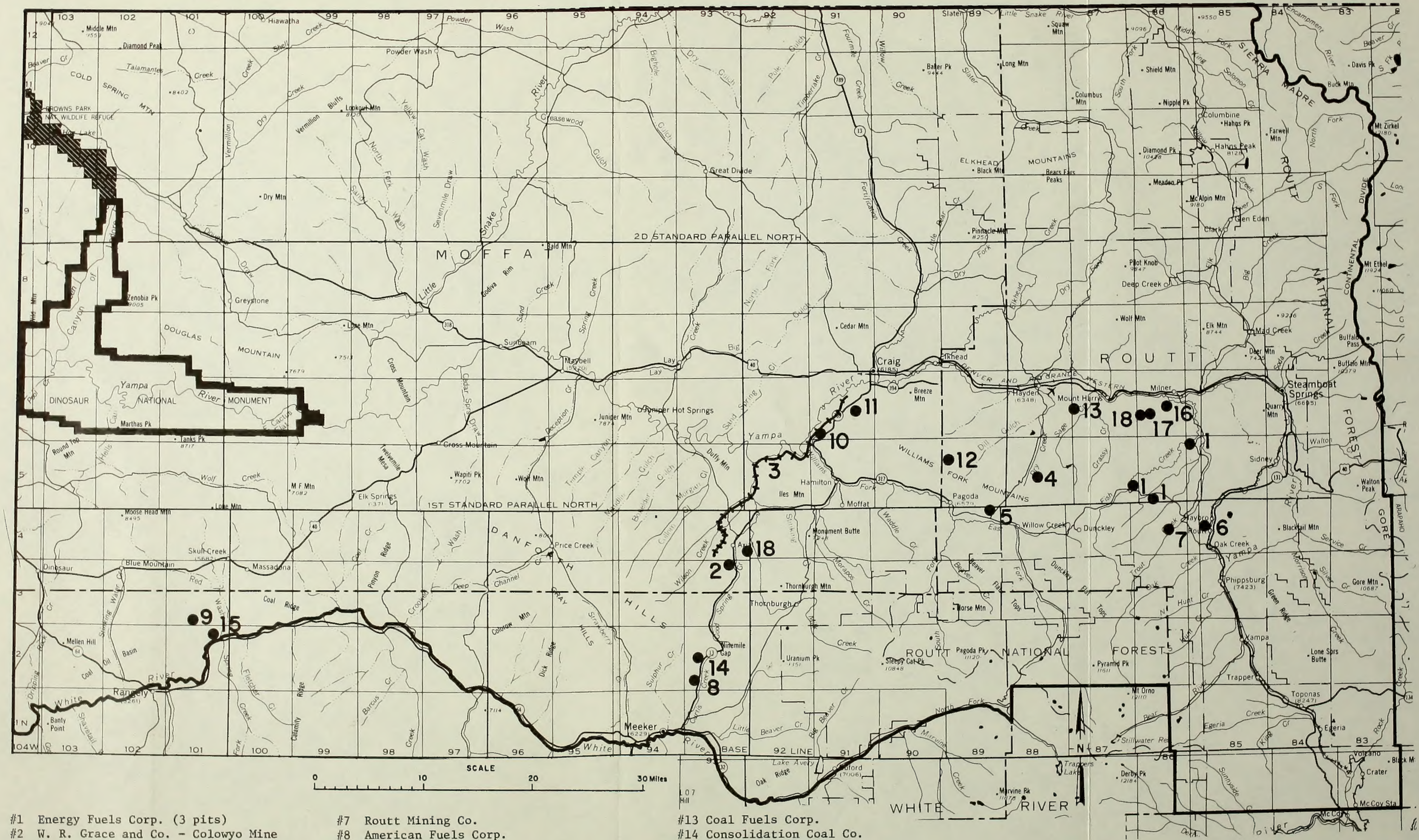
▨ Areas in which bituminous coal bearing rocks are 3,000 feet or more below the surface

▨ Areas in which subbituminous coal beds are probably more than 3,000 feet below the surface

Map Foldout 1. Northwest Colorado oil and gas fields and coal-bearing regions and fields

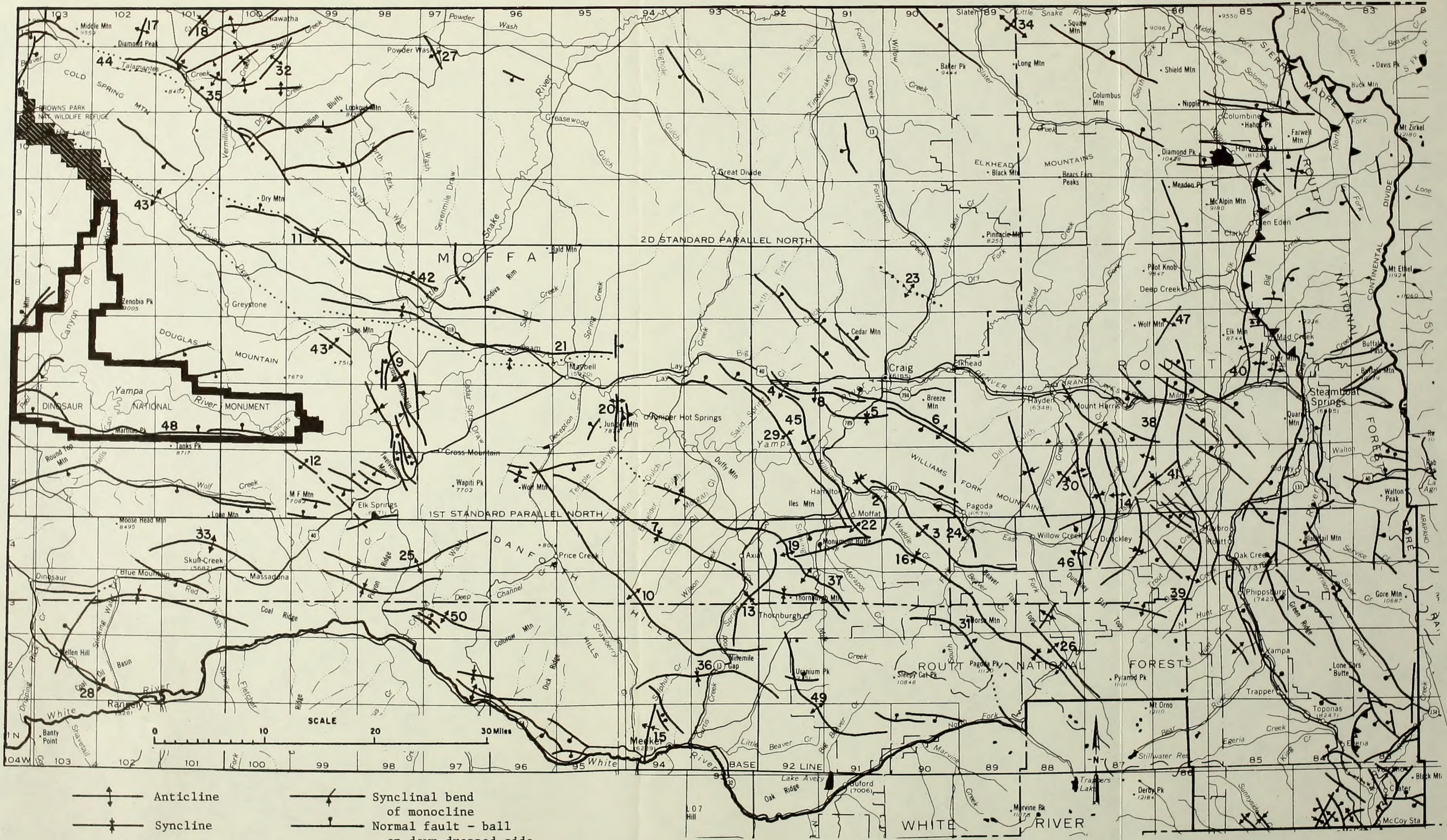


Map Foldout 2. Locations of coal leases and coal lease applications within the Northwest Colorado coal region.



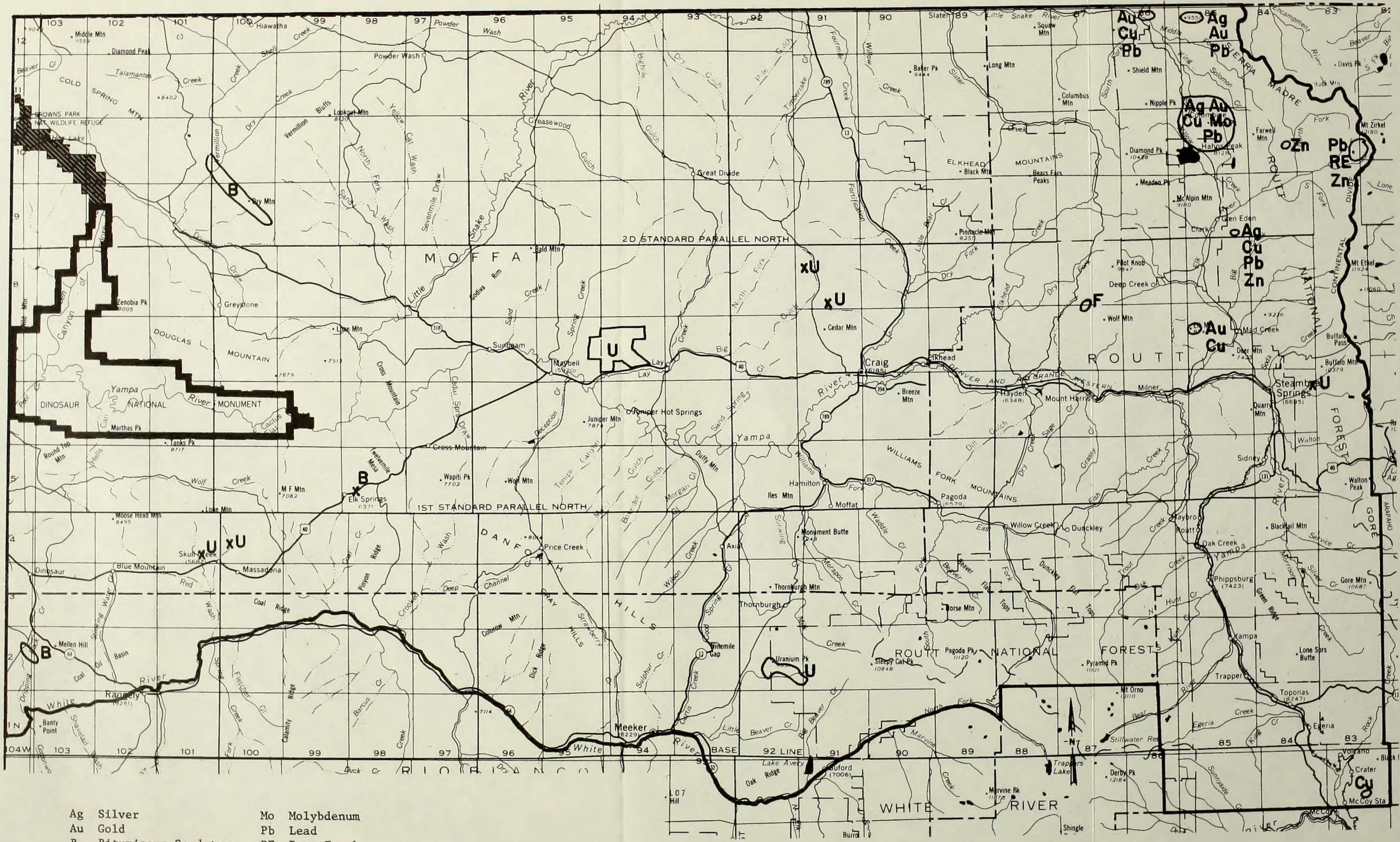
- #1 Energy Fuels Corp. (3 pits)
- #2 W. R. Grace and Co. - Colowyo Mine
- #3 W. R. Grace and Co. - Railroad
- #4 Peabody Coal Co.
- #5 Ruby Construction Co.
- #6 Pittsburg and Midway Coal Mining Co.
- #7 Routt Mining Co.
- #8 American Fuels Corp.
- #9 Moon Lake Electric Asso.
- #10 Empire Energy Corp.
- #11 Colorado Ute Electric Association
- #12 American Electric Power Service Corp.
- #13 Coal Fuels Corp.
- #14 Consolidation Coal Co.
- #15 Midland Coal Co.
- #16 Merchants Petroleum Co.
- #17 Thomas C. Woodward
- #18 Paul S. Coupey (2 sites)

Map Foldout 3. Locations of proposed actions



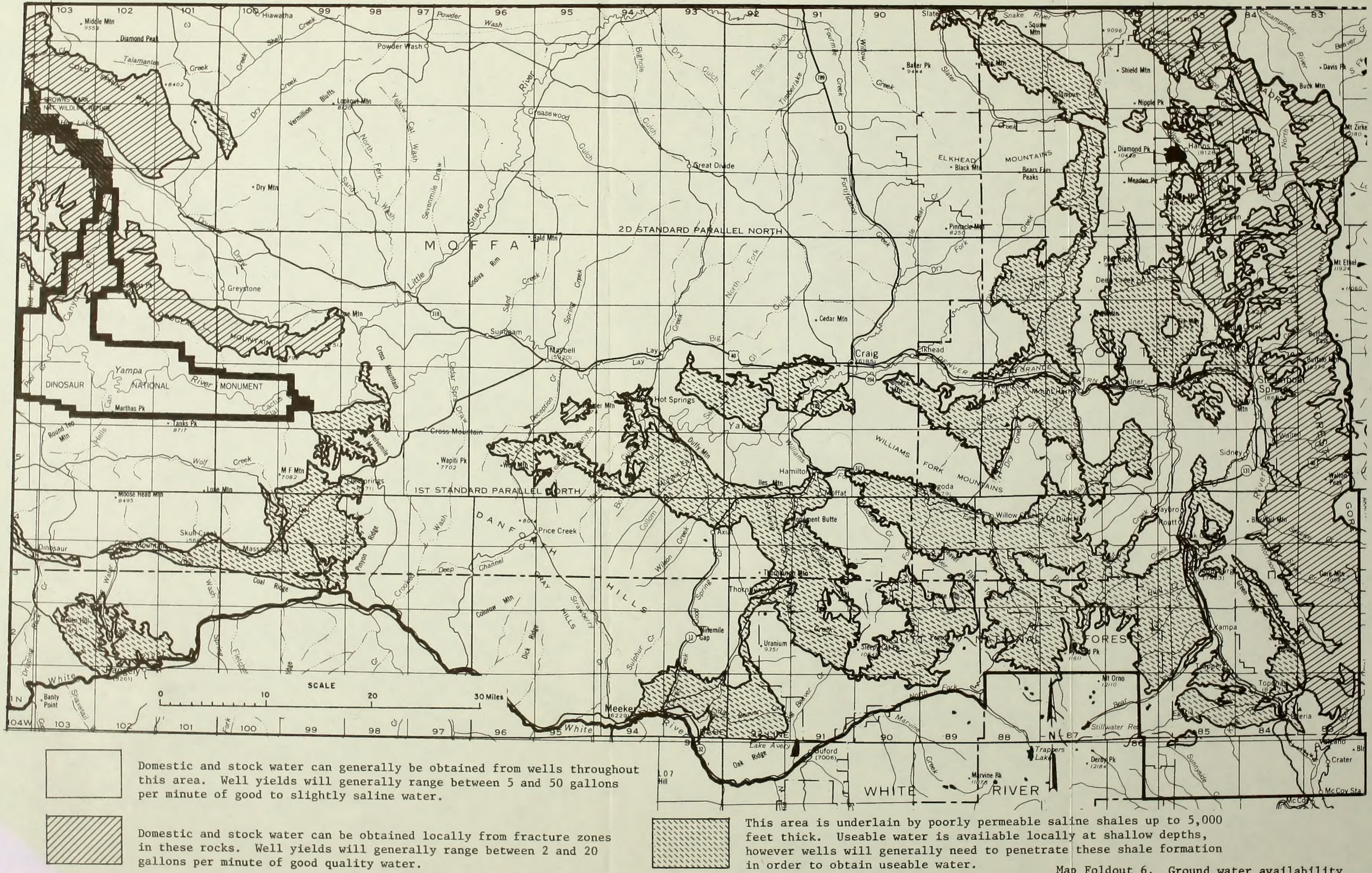
SOURCES: U.S.G.S. maps MF 130 and MF 666
Editorial staff, IAPG-RMAG Guidebook, August 1955

Map Foldout 4. Folds and faults of northwestern Colorado



Ag	Silver	Mo	Molybdenum
Au	Gold	Pb	Lead
B	Bituminous Sandstone	RE	Rare Earths
Cu	Copper	U	Uranium
F	Fluorite	Zn	Zinc

Map Foldout 5. Other selected minerals in northwest Colorado.

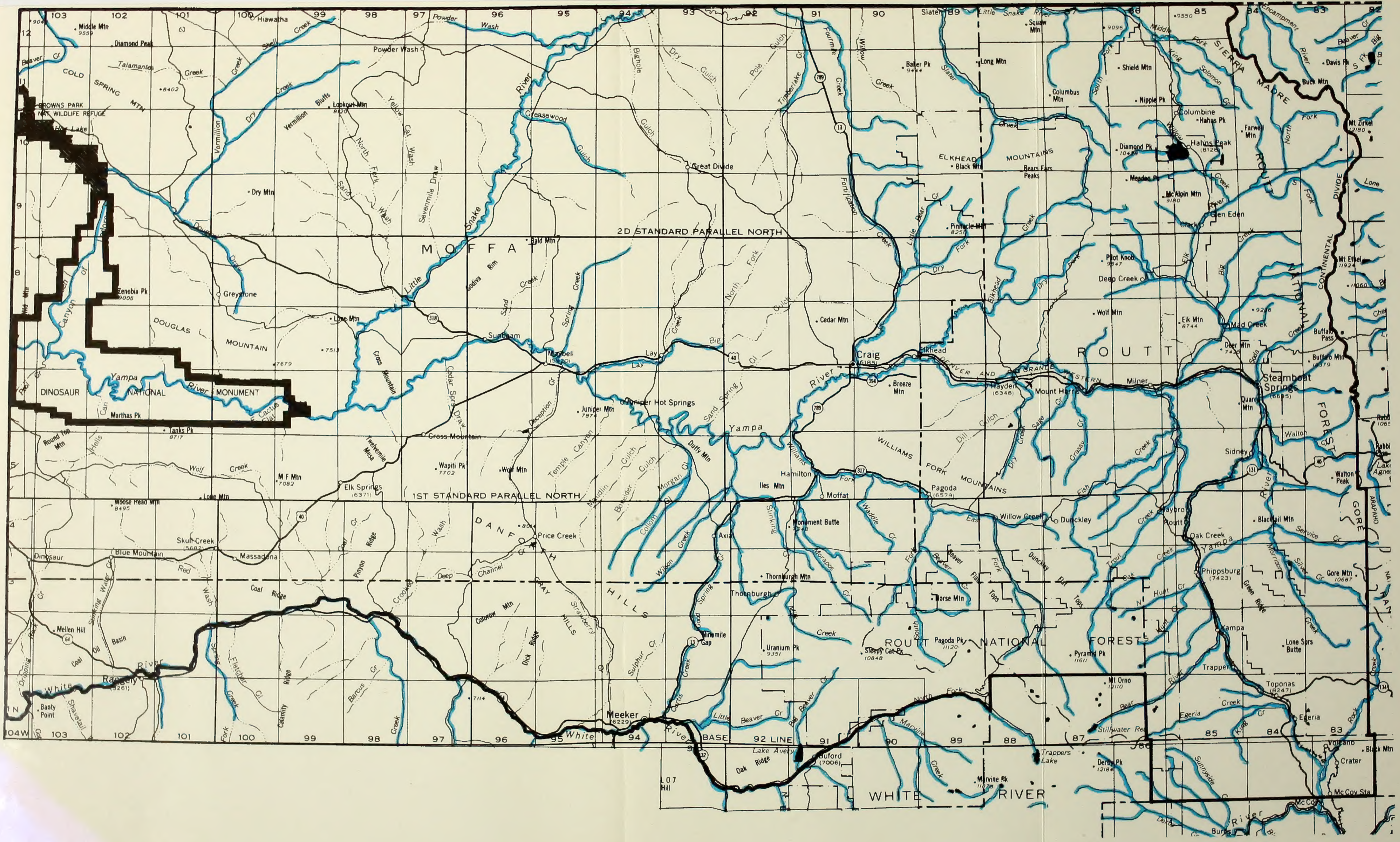


☐ Domestic and stock water can generally be obtained from wells throughout this area. Well yields will generally range between 5 and 50 gallons per minute of good to slightly saline water.

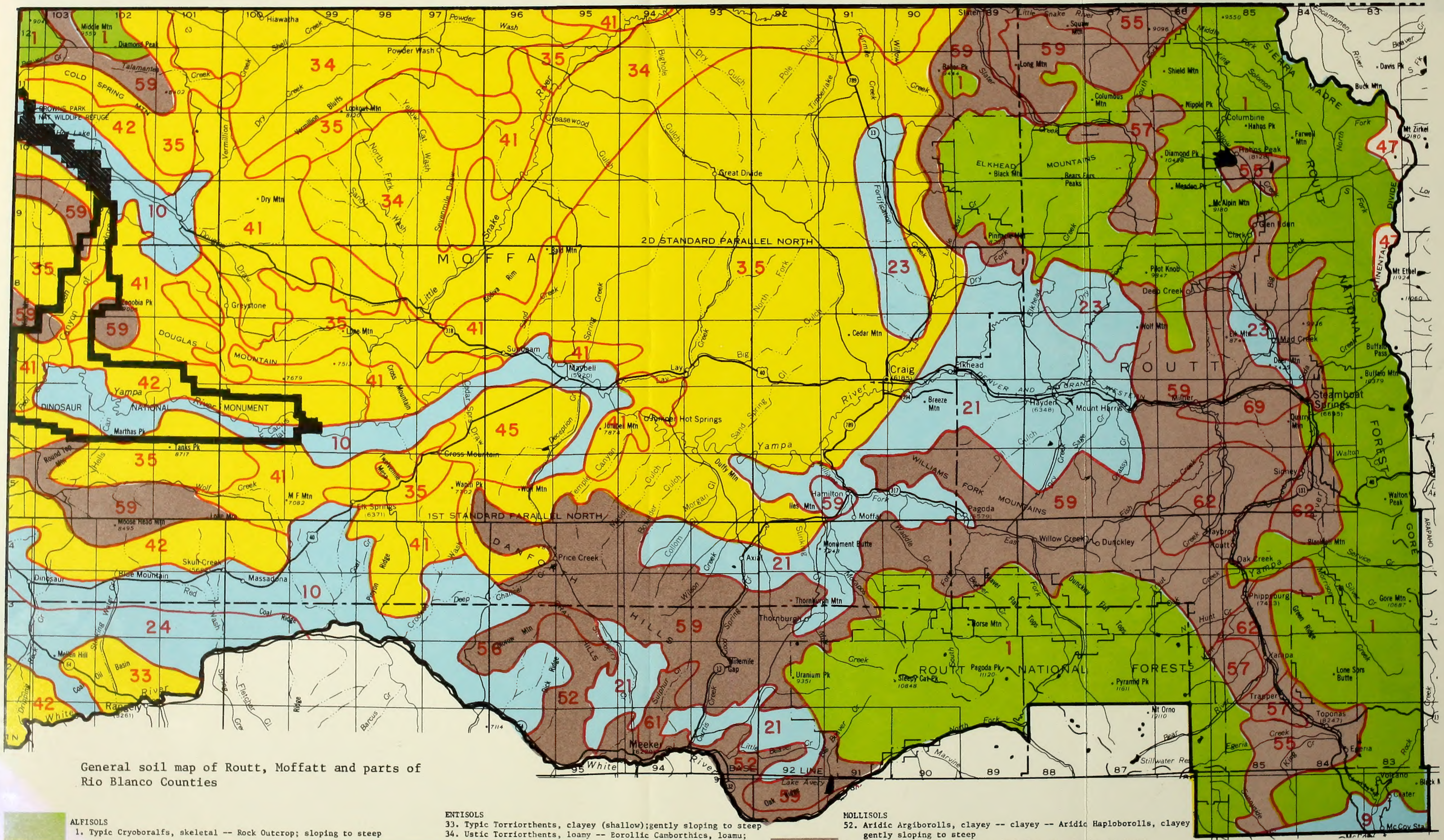
▨ Domestic and stock water can be obtained locally from fracture zones in these rocks. Well yields will generally range between 2 and 20 gallons per minute of good quality water.

▨ This area is underlain by poorly permeable saline shales up to 5,000 feet thick. Useable water is available locally at shallow depths, however wells will generally need to penetrate these shale formation in order to obtain useable water.

Map Foldout 6. Ground water availability



Foldout 7. Major water drainages of Routt, Moffatt and parts of Rio Blanco Counties



General soil map of Routt, Moffatt and parts of Rio Blanco Counties

🟩 ALFISOLS

1. Typic Cryoboralfs, skeletal -- Rock Outcrop; sloping to steep

🟦 ARIDISOLS

9. Borollic Haplargids, loamy -- Ustic Torriorthents, loamy; nearly level to moderately steep
10. Ustollic Haplargids, loamy; nearly level to gently sloping
21. Borollic Camborthids, clayey -- Aridic Argiborolls, loamy; gently sloping to moderately steep
23. Borollic Vertic Camborthids, clayey; gently sloping to moderately steep
24. Lithic Camborthids, loamy -- Lithic Ustic Torriorthents, loamy; steep

🟨 ENTISOLS

33. Typic Torriorthents, clayey (shallow);gently sloping to steep
34. Ustic Torriorthents, loamy -- Borollic Camborthics, loamu; gently sloping to moderately steep
35. Ustic Torriorthents, loamy-- Aridic Argiborolls, loamy; nearly level and gently sloping
41. Lithic Ustic Torriorthents, loamy -- Ustic Torriorthents, loamy; sloping to steep
42. Lithic Ustic Torriorthents, loamy -- Rock outcrop; gently sloping to steep
45. Ustic Torripsaments, gently sloping to steep

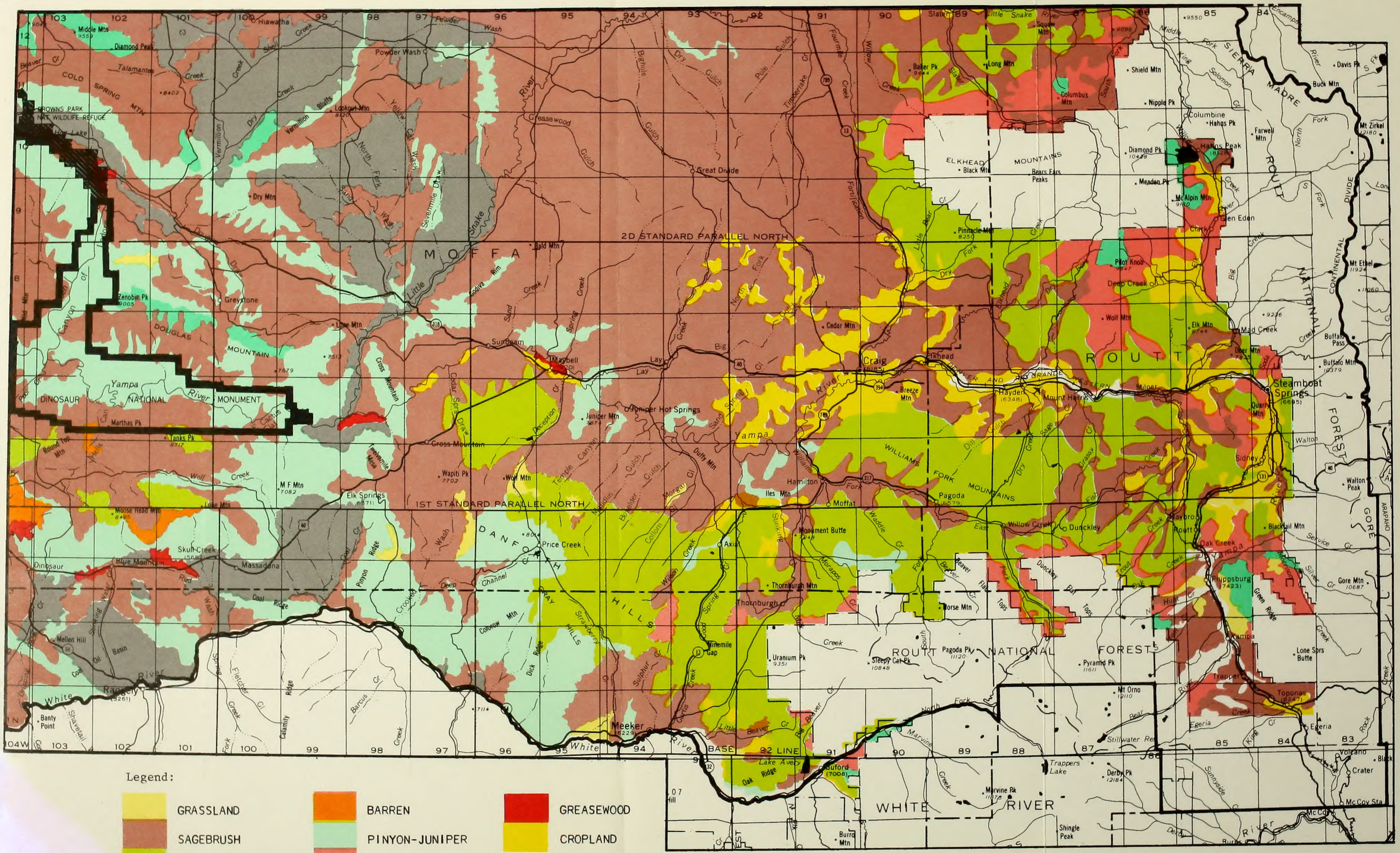
☐ INCEPTISOLS

47. Pergelic Cryumbrepts, skeletal -- Pergelic Cryochrepts skeletal --Rock Outcrop; sloping to steep

🟫 MOLLISOLS

52. Aridic Argiborolls, clayey -- clayey -- Aridic Haploborolls, clayey gently sloping to steep
55. Typic Cryoborolls, loamy -- Rock Outcrop; sloping to steep
56. Typic Cryoborolls, clayey -- Typic Cryoboralfs, skeletal; moderately steep and steep
57. Typic Cryoborolls, clayey -- Typic Cryorthents, clayey sloping to steep
59. Argic Cryoborolls, loamy -- Cryic Paleoborolls, loamy; nearly level to moderately steep
61. Lithic Haploborolls, skeletal -- Rock outcrop; moderately steep and steep
62. Typic Paleborolls, clayey -- Borollic Camborthids, clayey gently sloping to moderately steep

Foldout 8.



Legend:

GRASSLAND

SAGEBRUSH

MOUNTAIN SHRUB

CONIFER

BARREN

PINYON-JUNIPER

ASPEN

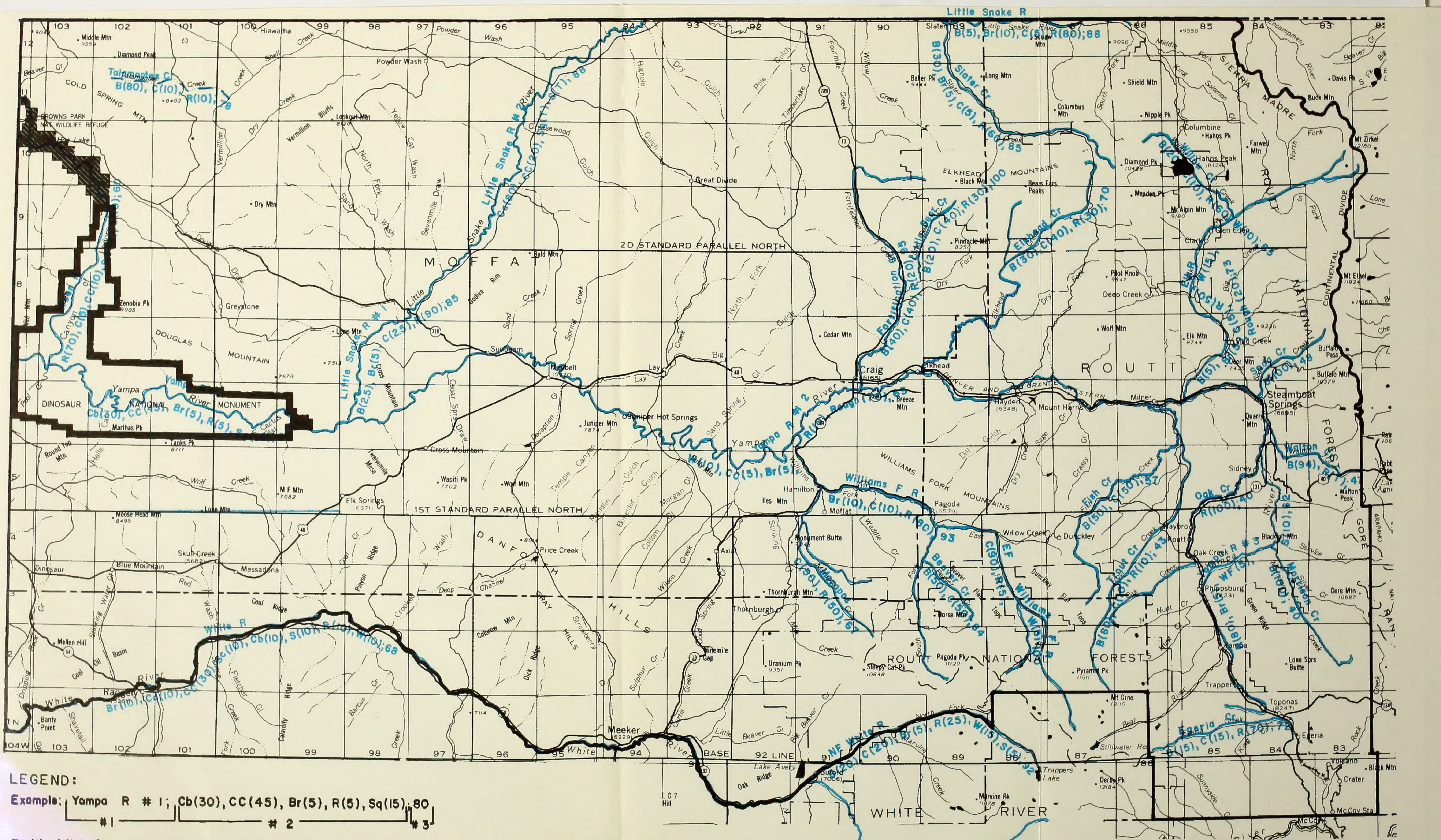
SALTBUSH

GREASEWOOD

CROPLAND

RIVERBOTTOM

Foldout 9. Vegetative types of Moffatt and parts of Routt and Rio Blanco Counties



LEGEND:

Example: Yampa R # 1; Cb(30), CC(45), Br(5), R(5), Sq(15); 80
#1 #2 #3

Position: # 1 Stream Name - Yampa R # 1 = Yampa River Section 1
# 2 Fish species present and percent composition - Cb(30) = 30% Chubs, CC(45) = 45% Channel Catfish, Br(5) = 5% Brown Trout, Sq(15) = 15% Squawfish

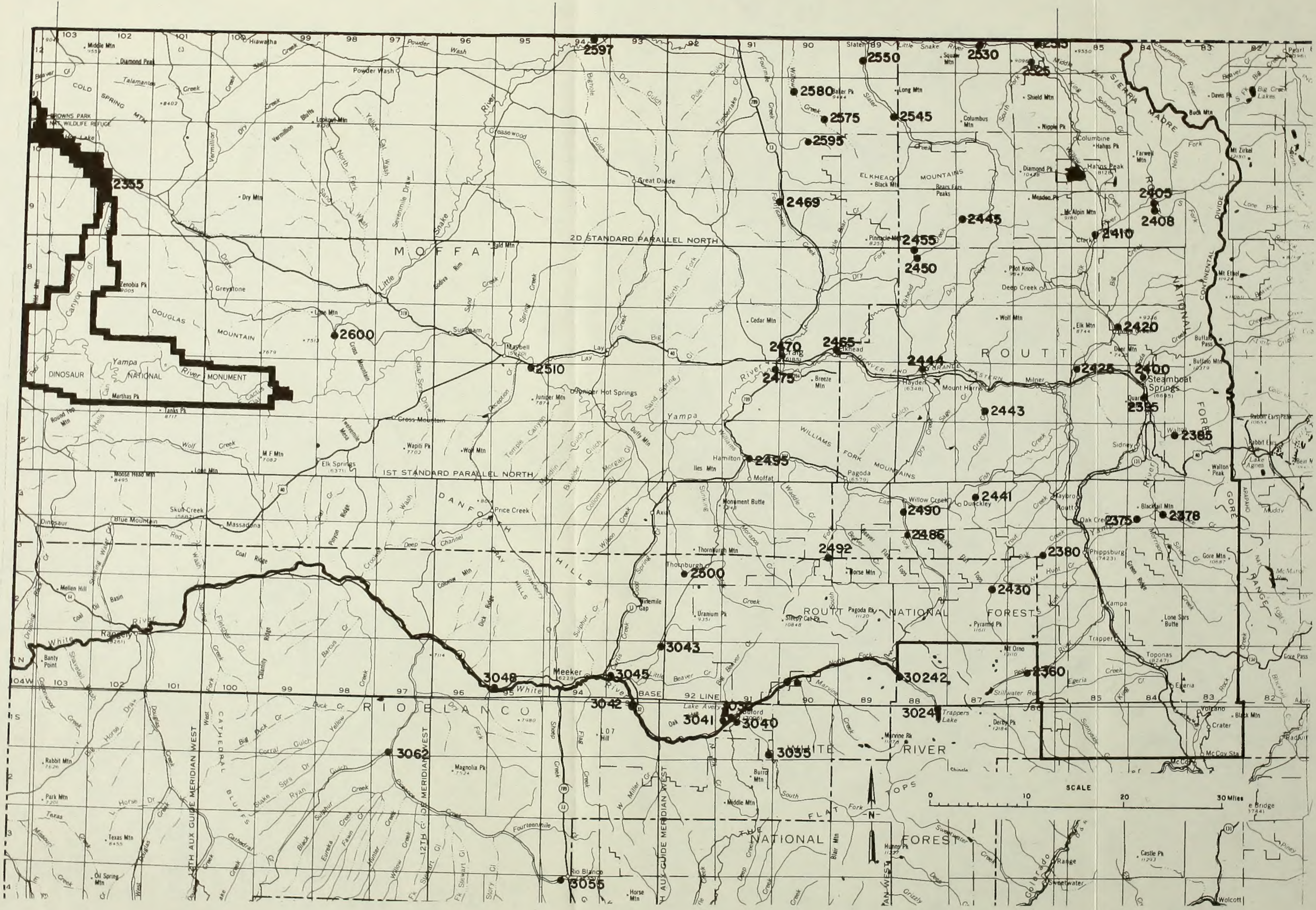
# 3 Stream fishery value rating — 60 and below = Poor; 61-74 = Fair; 75-85 = Good; 86 and above = Excellent

Other Abbreviations Used:

Stream Name C = Creek, F = Fork, S = South, N = North, E = East,

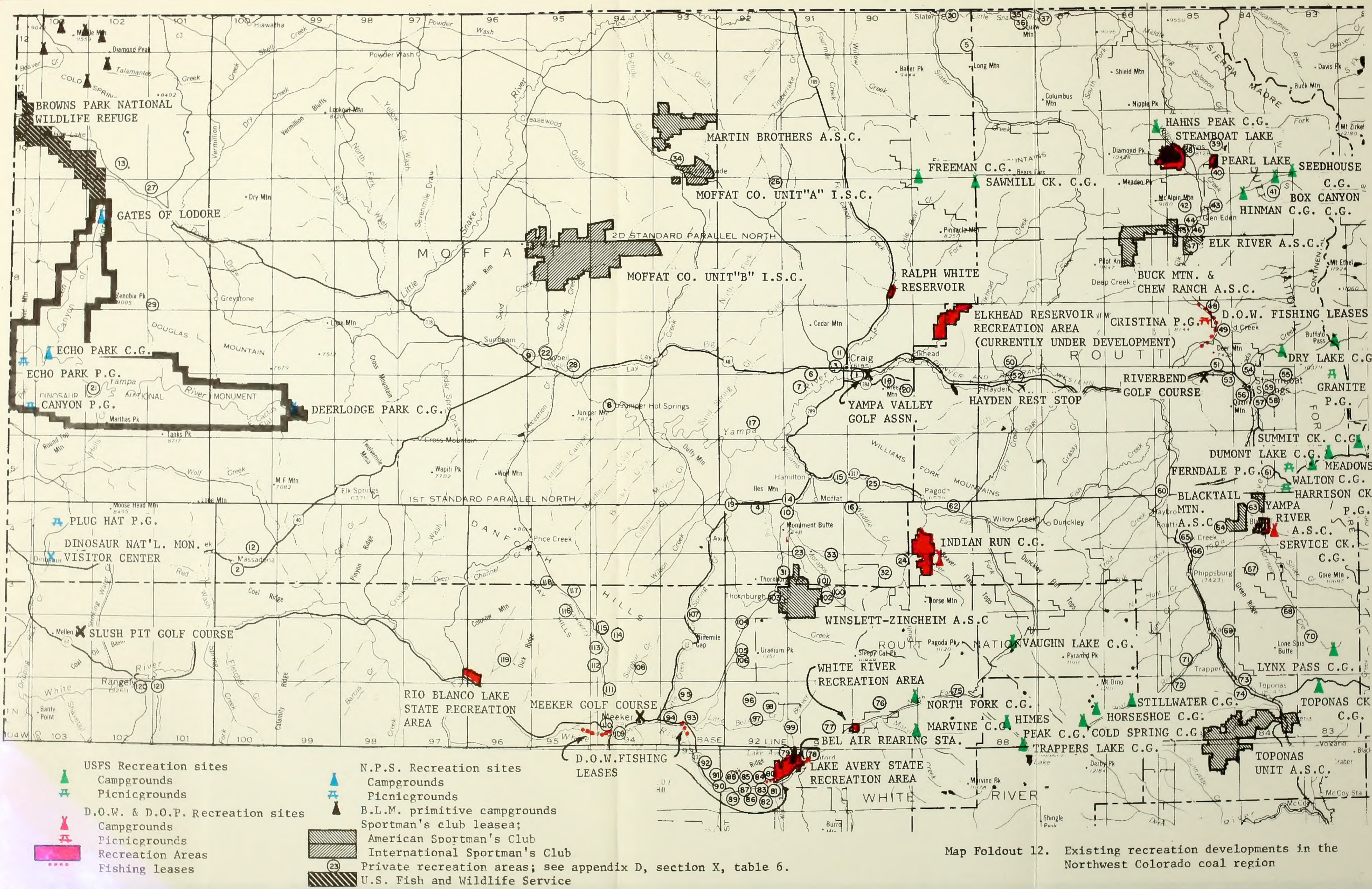
Fish species present B = Brook Trout, C = Cutthroat Trout, Rough = Rough Fish, S = Suckers, W = Whitefish, Ca = Carp, Sc = Sculpin

Foldout 10. Major stream fisheries in the analysis area

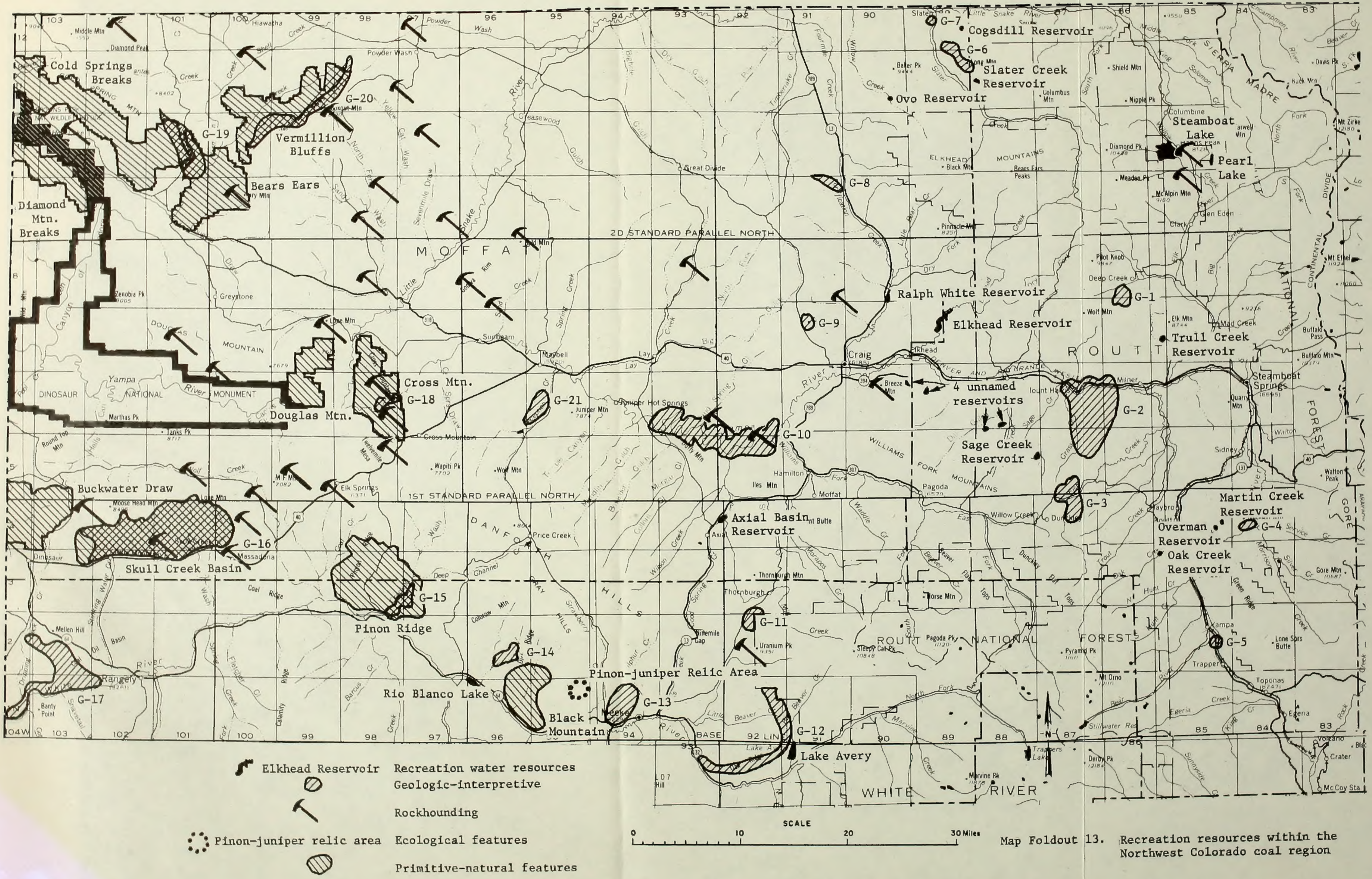


2534, an abbreviated identification number, refers to an 8 digit station number 09253400

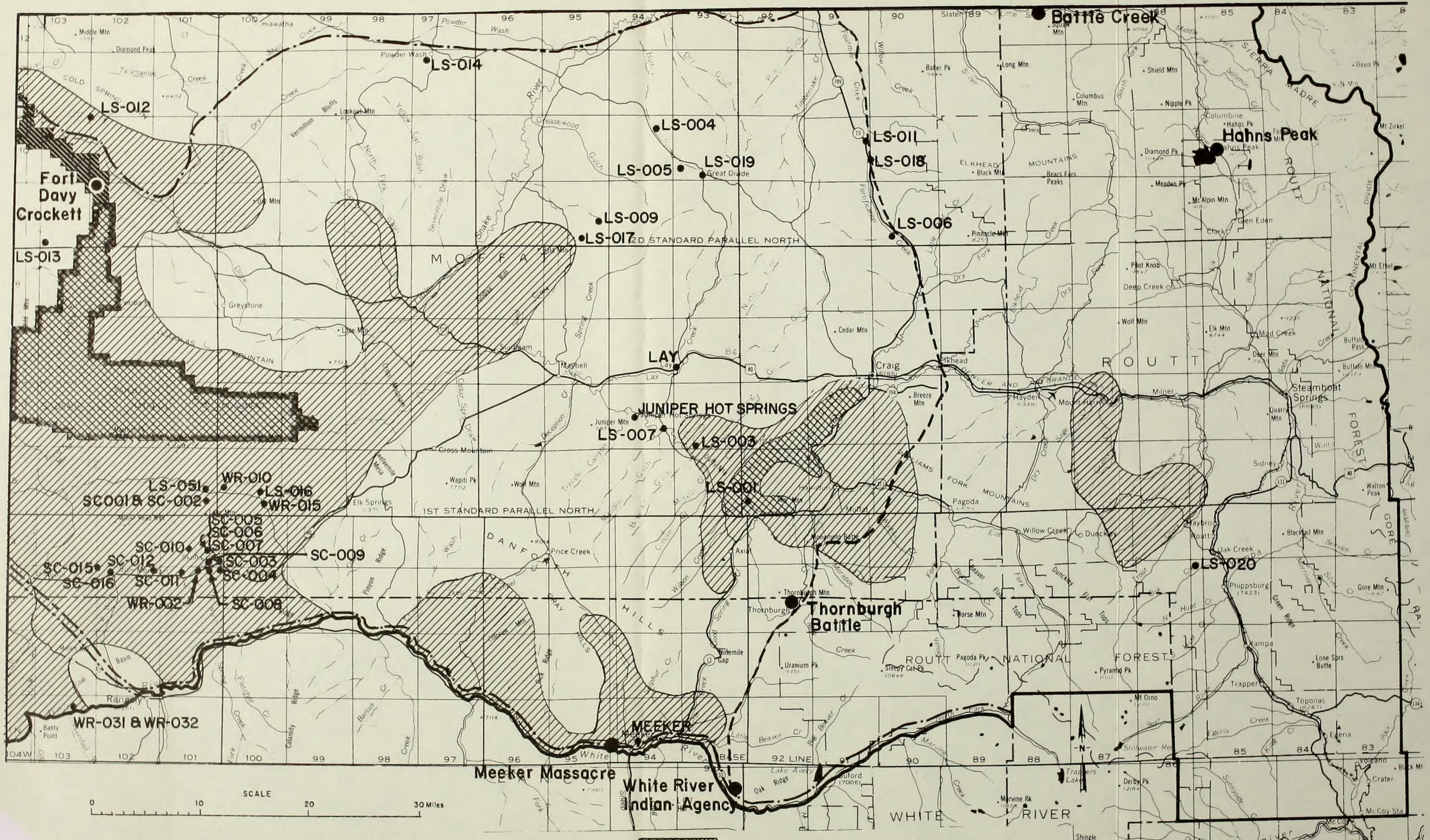
Map Foldout 11. Locations of surface water gaging stations



Map Foldout 12. Existing recreation developments in the Northwest Colorado coal region



Map Foldout 13. Recreation resources within the Northwest Colorado coal region



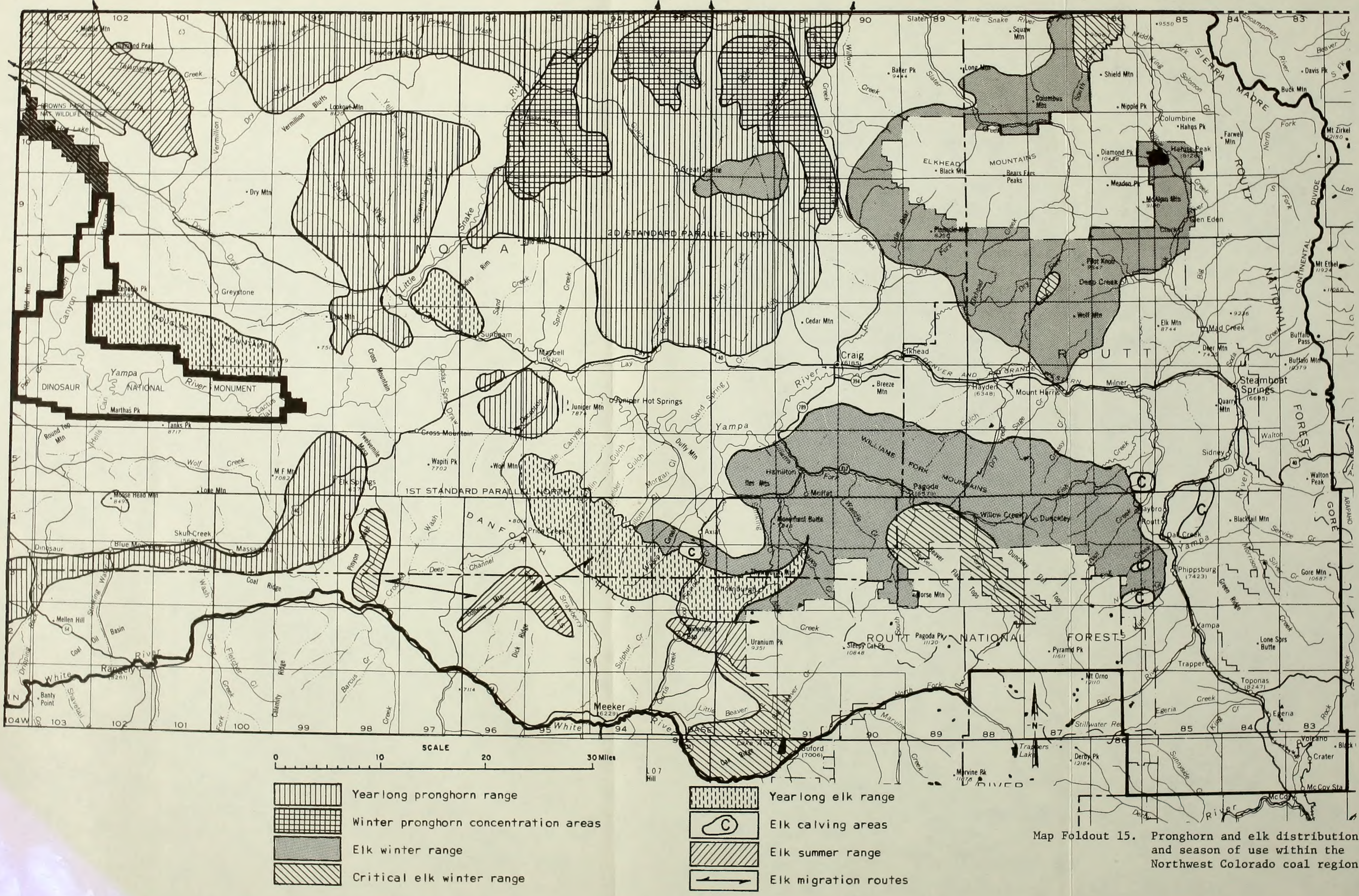
Historic trails and exploration routes:

- Dominquez Escalante (1776)
- Fremont Expedition (1844)
- White River Indian Agency trail (1868)
- ● Other Historic Resources

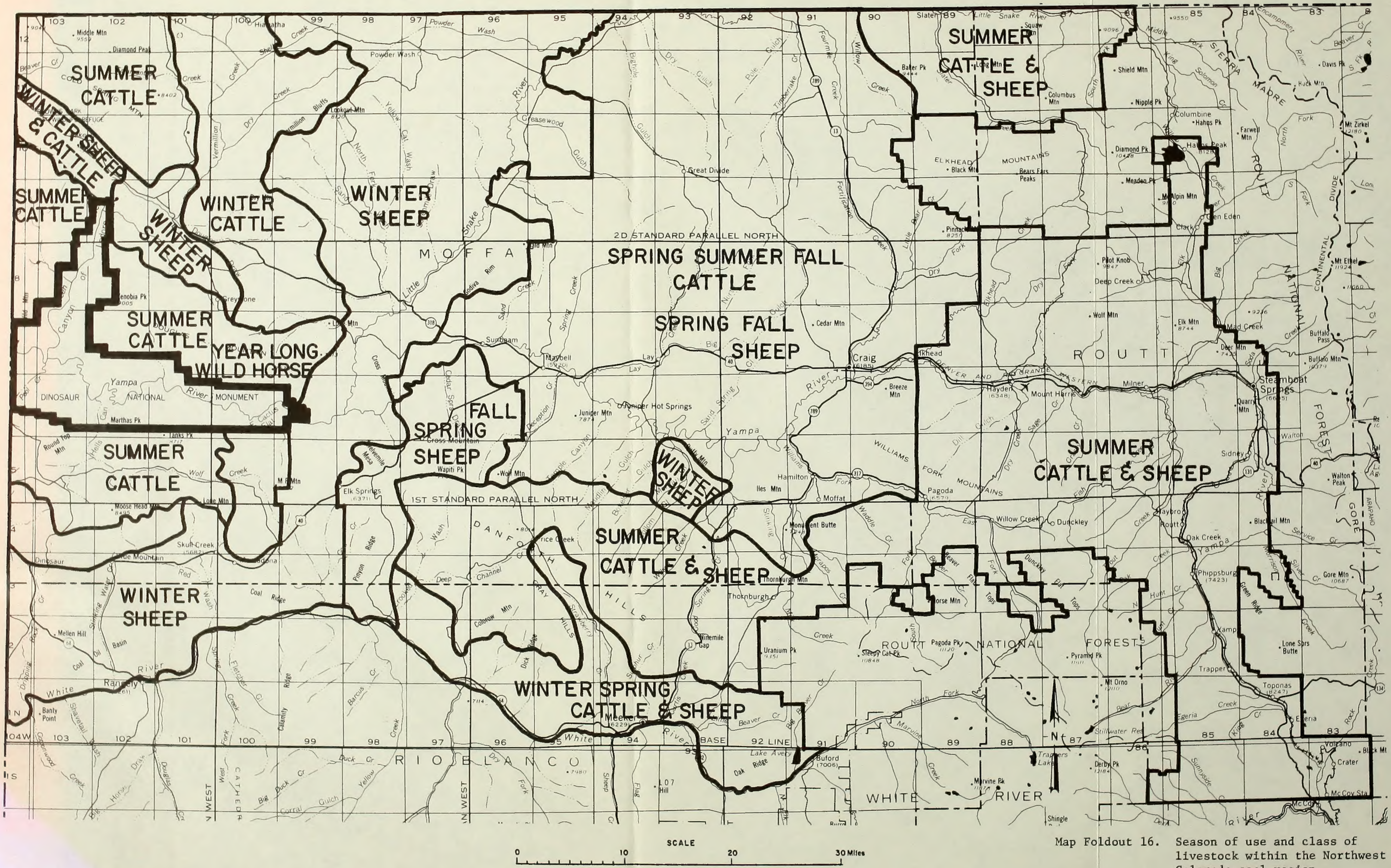
Archeological site density:

- ▩ High (approximately 1 site/section)
- ▨ Medium (approximately 1 site/township)
- ☐ Low (less than 1 site/township)

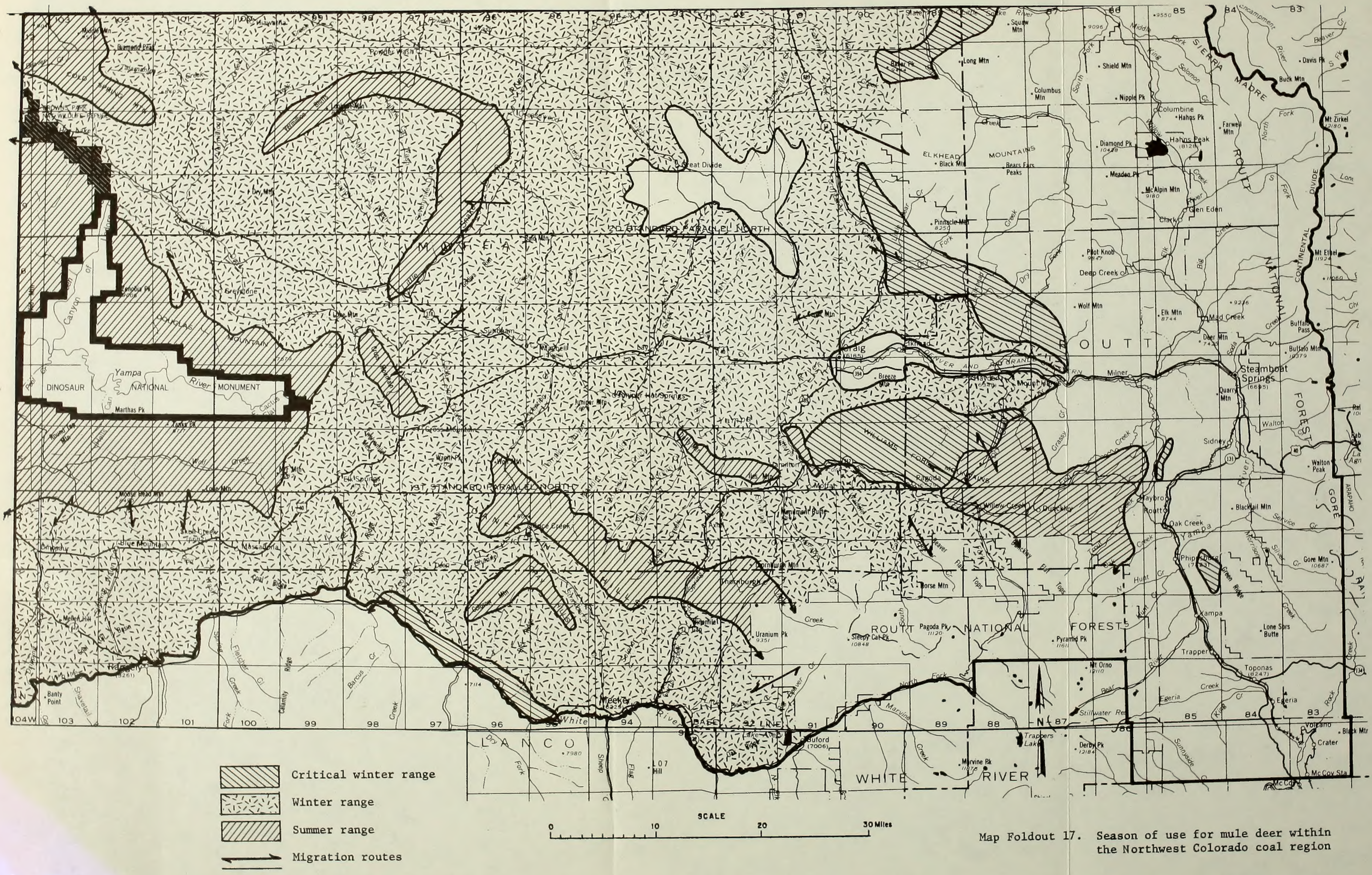
Map Foldout 14. Known archeological and historical resources (based on intensive survey of approximately one percent of the study region)



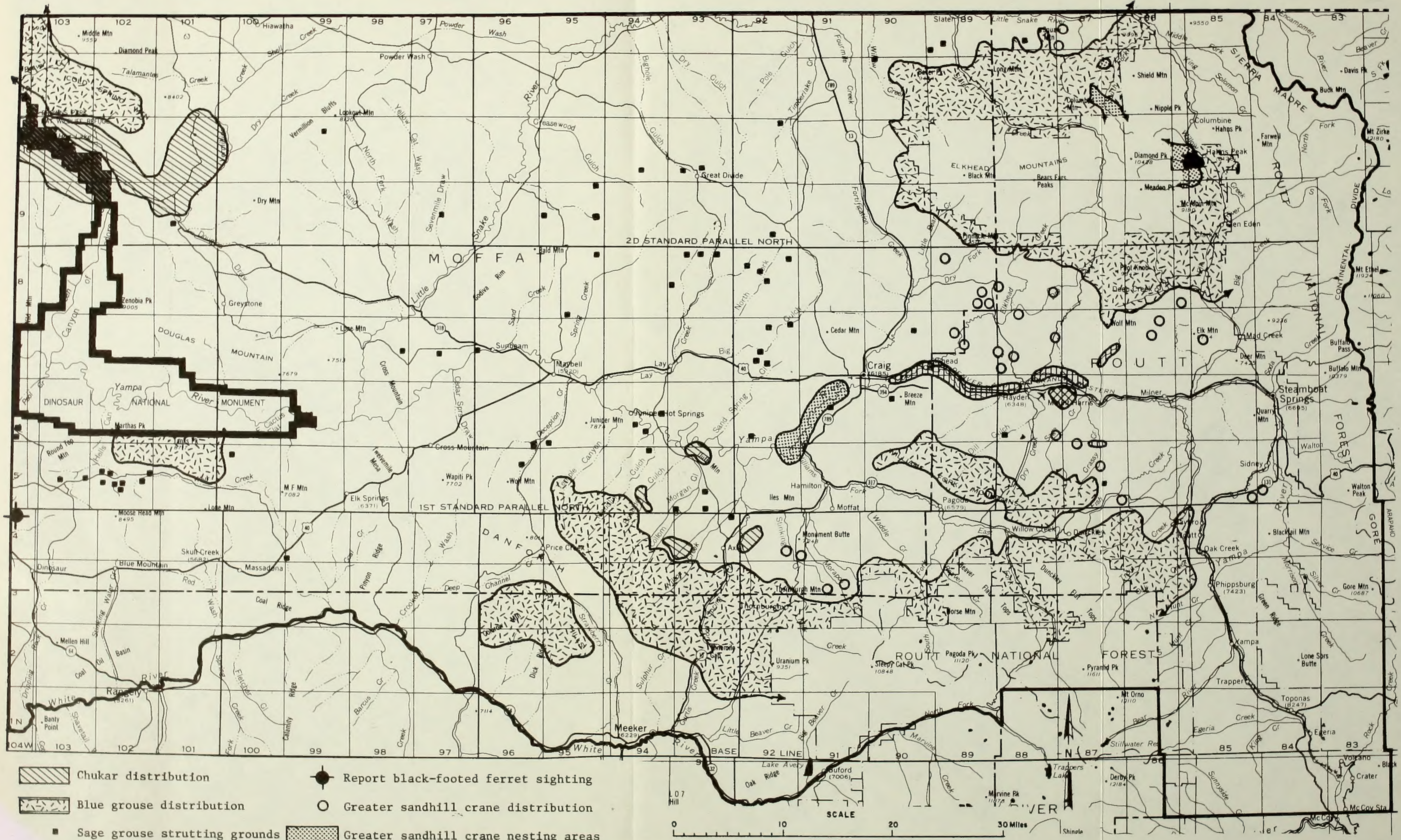
Map Foldout 15. Pronghorn and elk distribution and season of use within the Northwest Colorado coal region



Map Foldout 16. Season of use and class of livestock within the Northwest Colorado coal region



Map Foldout 17. Season of use for mule deer within the Northwest Colorado coal region



▨ Chukar distribution

▨ Blue grouse distribution

■ Sage grouse strutting grounds

▥ Sharp-tail strutting grounds

✦ Report black-footed ferret sighting

○ Greater sandhill crane distribution

▩ Greater sandhill crane nesting areas

▩ Greater sandhill crane dancing area

Map Foldout 18. Distribution of some important wildlife species within the Northwest Colorado coal region

Appendix C
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Appendix C
Glossary

GLOSSARY

Accipiter. Members of the Subfamily Accipitrinae of the Order Falconiformes; includes the goshawk, Coopers hawk and sharp-shinned hawk.

Acre-foot. A unit for measuring volume, equal to the quantity of water or other material required to cover one acre to a depth of one foot or a volume of 43,560 cubic feet.

Activity day. Participation in an outdoor recreation activity by one user for any period of a day.

Alkali soil. (1) A soil with a high degree of alkalinity (pH of 8.5 or higher), or with a high exchangeable sodium content (15 percent or more of the exchange capacity), or both. (2) A soil that contains sufficient alkali (sodium) to interfere with the growth of most crop plants.

Alluvial fan. A low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan or a segment of a cone, deposited by a stream at the place where it issues from a narrow valley upon a plain or broad valley.

Alluvial soils. An azonal great soil group developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes.

Alluvium. Clay, silt, sand, and gravel or other rock material transported by flowing water, and deposited as sorted or semi-sorted sediments.

Ammonite. A marine animal with a shell that has a complex suture pattern.

Animal unit month. Pounds of forage or feed required to sustain one animal unit (e.g., 1 cow or 5 sheep) for a period of 30 days. (Abbreviated: AUM; Plural: AUMs).

Annual plant. A plant that completes its life cycle and dies in one year or less.

Anthracite. Coal of the highest metamorphic rank, in which fixed-carbon content is between 92% and 98%. It is hard, black, and has a semi-metallic luster and semi-conchoidal fracture.

Anticline. A fold, the core of which contains the stratigraphically older rocks; it is convex upward.

Archeological excavation. In a salvage situation in which sites will be destroyed as a result of construction, excavation is often the only means of information salvage. Sites are selected for excavation on the basis of a survey. The intent is to select a representative sample of every type of site from every time period. The sites so selected typically range from 5-10 percent of the sites located in the survey. All excavated materials are subjected to intensive laboratory analysis, description, and publication. By definition it is in itself a destructive activity, as the in-place value of the resource is destroyed through excavation.

Archeological inventory. An inventory is an attempt to locate every site within a specified region, or in the case of a right-of-way, every site along the right-of-way. The inventory requires covering the surface on foot, horseback, or vehicle, in transect intervals of 100 yards or less. An inventory produces as the end product an itemized description of each site, its location on a suitable detailed map, a photograph, and a collection of artifacts from the surface of each site.

Archeological literature search. An examination of published reports, manuscripts, and site survey files to determine site types and cultures present within an area. Occasionally it is possible to estimate site density and site situations utilized. Such a search is useful for the preparation of an environmental assessment and field study plans.

Archeological reconnaissance. A cursory examination of a region to locate actual sites as a means of determining site situations utilized and site types present. Normally such a study is conducted according to some sampling design.

Archeological resources. Objects and areas made or modified by man and the data associated with these artifacts and features. These resources rest in or on the ground.

Archeological survey. A survey is an extension of an inventory. In addition to site location the site collections are analyzed and each site is assigned to a culture period or periods. The analysis includes laboratory study of artifacts: cleaning, labelling, typological analysis, etc. If acquired, any datable samples are submitted for dating. The site types and artifacts are described in a published report which synthesizes all of the known archeological data in the region studied.

Arkosic sandstone. A sandstone with considerable feldspar.

Artesian. Is synonymous with confined. Artesian water and artesian water body are equivalent respectively to confined ground water and confined water body.

Artesian well. Is a well deriving its water from an artesian or confined water body. The water level in an artesian well stands above the top of the artesian water body it taps.

Artifact. A material object made or modified in whole or in part by man. Among the most common artifacts or archeological sites are stone tools, chips, projectile points, and similar lithic debris.

Asymmetric fold. A fold, the limbs of which have different angles of dip relative to the axial surface, which is not vertical.

Autecology. Deals with the study of individual organisms or an individual species.

Available water-holding capacity (soils). The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil.

Average annual precipitation. An average of the yearly precipitation usually expressed in inches of water that fall or are computed to fall at a point or on an area during a specified number of calendar or water years.

Axis. (fold) In a fold, a line that connects the central points of each constituent stratum, from which its limbs bend; in a syncline, it is the trough, and in an anticline it is the crest.

Backfill. The process of filling, or the material used to fill, a surface mine pit.

Background. That portion of the visual landscape lying from the middleground limits to infinity. Color and texture are subdued in these landscapes, which are concerned with the two-dimensional shape of landforms against the sky.

Badlands. Extremely rough, high, narrowly and steeply gullied topography in arid or semiarid areas that are horizontally bedded and have a dry, loose soil.

Ballast. Rough, unscreened gravel, sand, and broken stone used as foundation for roads, especially that laid in the roadbed of a railroad to provide a firm surface for the track, to hold the track line, and to facilitate drainage.

Base flow. Sustained or fair-weather streamflow. In most streams, base flow is composed largely of ground water effluent.

Baseline data. Information collected prior to the initiation of an environmental analysis which forms a basis for the determination of environmental impacts.

Bed. A subdivision of a stratified sequence of rocks, lower in rank than a member or formation, internally composed of relatively homogeneous material exhibiting some degree of lithologic unity, and separated from the rocks above and below by visually or physically more or less well-defined boundary planes; "the smallest rock-stratigraphic unit recognized in classification."

Bedrock. The more or less solid rock in place either on or beneath the surface of the earth.

Belt conveyor. A moving, endless belt that rides on rollers and on which materials can be carried for various distances.

Beneficiation. Improvement of coal quality by separating out low quality material (by use of air or water).

Benthic. Bottom-dwelling.

Biochemical oxygen demand (BOD). The measure of the relative oxygen requirements of municipal and industrial wastewaters.

Biomass. Living weight.

Biomes. The major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions.

Boxcut. The initial pit in a strip mine where no open side exists; this results in a highwall on both sides of the pit.

Brachiopod. A bivalved marine invertebrate.

Breaks. Rough, broken topography--in many places the transition area between highlands and lowlands.

Browse. The part of leaf and twig growth of shrubs, woody vines, and trees available for animal consumption.

Btu. Abbreviation for the British thermal unit. Amount of heat needed to raise 1 pound of water 1 degree F (252 calories).

Buteo. Members of the Subfamily Buteoninae of the Order Falconiformes; includes eagles and broadwinged hawks, such as the red-tailed hawk, Swainsons hawk, rough-legged hawk, and ferruginous hawk.

Calcareous rock. A sedimentary rock containing an appreciable amount of calcium carbonate.

Carbonaceous. Said of a rock or sediment that is rich in carbon; coaly.

Carnivore. Flesh eater.

Carrion. The decaying flesh of a dead body.

Carrying capacity. The uppermost limit of a specific area's ability to support a given population.

Cephalopod. A marine invertebrate with a well-defined head and tentacles around the mouth (includes squid and the pearly Nautilus.)

Channery. Soil mass containing between 15 and 90 percent by volume of fragments.

Characteristic Landscape. The overall visual impression resulting from the combination of topography, vegetation, water resources, and cultural features that can be described in terms of the visual dominance elements.

Chemical Quality of Water. A term that embodies all the chemical and physical properties or attributes of water which are imparted to the water by the amounts and kinds of chemical constituents in colloidal suspension or dissolved in the water.

Chemical-quality station. A particular site on a stream, canal, lake, or reservoir where water samples are collected on a systematic basis for chemical study.

Chert. An impure flint (cryptocrystalline quartz), usually brown or grey-black, used for chipped stone implements.

Clastic. Pertaining to or being a rock or sediment composed principally of broken fragments that are derived from pre-existing rocks or minerals, and that have been transported individually for some distance from their places of origin; also said of the texture of such a rock.

Coal. A solid, brittle, dark brown to black, combustible, carbonaceous rock formed by the partial to complete decomposition of vegetation.

Colluvium. Loose, unconsolidated clay, silt, sand, and gravel at the foot of a slope, brought there by force of gravity.

Color. The property of reflecting light of a particular wavelength; dust or moisture-laden air fades its intensity in the middleground, and to a greater extent in the background.

Community. An aggregate of organisms which form a distinct ecological unit. Such a unit may be defined in terms of plants, animals, or both.

Concentration. A term used to describe the amounts of a material or substance in relation to the total mixture. In this report concentration is expressed in parts per million and in equivalents per million.

Concretion. A hard, compact, rounded, normally subspherical (but commonly very oblate or disk-shaped, and sometimes of irregular form with odd or fantastic outlines) mass or aggregate of mineral matter generally formed by orderly and localized precipitation from aqueous solution.

Conglomerate. A coarse-grained, clastic sedimentary rock composed of rounded (to subangular) fragments larger than 2 mm in diameter (granules, pebbles, cobbles, boulders) set in a fine-grained matrix of sand, silt, or any of the common natural cementing materials; the consolidated equivalent of gravel both in size range and in the essential roundness and sorting of its constituent particles.

Consequent stream. A stream that originates on a newly exposed or recently formed surface and that flows along a course determined entirely by the initial slope and configuration of that surface; a stream whose direction of flow is directly related to and a necessary consequence of the original dip-slope surface of the land and the geologic structure of the area.

Consumptive use. The quantity of water discharged to the atmosphere or incorporated in the products of the process in connection with domestic use, vegetative growth, food processing, or an industrial process.

Continental Deposit. A sedimentary deposit laid down on land (whether a true continent or only an island) or in bodies of water (whether fresh or saline), not directly connected with the ocean, as opposed to a marine deposit.

Contour furrows. Furrows plowed approximately on the contour on pasture or rangeland to prevent soil loss and increase infiltration. Also, furrows laid out approximately on the contour for irrigation purposes.

Crustacean. A class of invertebrates that usually live in water and breathe through gills; they have a hard outer shell and jointed appendages and bodies.

Cubic feet per second (cfs). A unit expressing rates of discharge, equal to the discharge through a rectangular cross section, one foot wide and one foot deep, flowing at an average velocity of one foot per second.

Cuesta. A hill or ridge with a gentle slope on one side and a steep slope on the other; specifically an asymmetric ridge with one face (dip slope) long and gentle and conforming with the dip of the resistant bed or beds that form it, and the opposite face (scarp slope) steep or even cliff-like and formed by the outcrop of the resistant rocks, the formation of the ridge being controlled by the differential erosion of the gently inclined strata. If the beds dip more than about 20°, such a ridge would be termed a hogback rather than cuesta.

Cultural resources. Objects, structures, sites, and districts that pertain to native peoples, or other communities; they are generally classified as historic and prehistoric (often referred to as archeologic). Such areas are important because of their educational, interpretive, and scientific value, because they are vital to the preservation of a subculture, or because they are representative examples.

Debris slide. A landslide involving a slow-to-rapid downslope movement of comparatively dry and predominantly unconsolidated and incoherent earth, soil, and debris in which the mass does not show backward rotation (as in a slump) but slides or rolls forward.

Degradation. The wearing down or away, and the general lowering or reduction of the Earth's surface by the natural processes of weathering and erosion.

Detrital. Pertaining to or formed from detritus; said especially of rocks, minerals, and sediments.

Detritus. A collective term for loose rock and mineral material that is worn off or removed directly by mechanical means, as by disintegration or abrasion; especially fragmental material, such as sand, silt, and clay, derived from older rocks and moved from its place of origin.

Diatoms. Microscopic plants in an aquatic ecosystem.

Dip. The angle that a structural surface, e.g., a bedding or fault plane, makes with the horizontal, measured perpendicular to the strike of the structure.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming with the direction and the angle of dip of the underlying rocks; specifically the long, gently inclined face of a cuesta.

Direct runoff. The water from rainfall or melting snow that enters the stream system rapidly either as overland flow or as subsurface flow that does not reach the zone of saturation, and whose time spent underground is so brief that its rate of movement into the stream is almost as rapid as overland flow.

Discharge. The process by which water moves from an aquifer, or the amount of water that moves from an aquifer.

Dissolved solids. Solids that originate mostly from rocks and are in solution. Some colloidal material is treated as if it were in solution in determining dissolved solids. The total dissolved mineral constituents of water.

Dissolved-solids discharge. (1) the rate at which dry weight of dissolved solids passes a section of a stream or other conveyance channel, or (2) the quantity of dissolved solids, measured by dry weight or by volume, that is discharged in a given time.

Dissolved-solids yield. A unit for expressing the discharge of dissolved solids or sediment from an area. Sediment yield and dissolved-solids yield is usually given in tons per square mile per year.

Dissolved oxygen (DO). A measure of the oxygen content of a volume of water.

Dome. (fold) An uplift or anticlinal-type structure, either circular or elliptical in outline, in which the rock dips gently away in all directions.

Down dip. A direction that is downwards and parallel to the dip of a structure or surface.

Dragline. A type of excavating equipment which casts a rope-hung bucket and collects dug material by pulling the bucket with a second rope.

Dry farming. Farming without irrigation.

Ecology. The study of the relation of organisms or groups of organisms to their environment; animals and plants in their relation to each other.

Ecosystem. Complex self-sustaining natural system which includes living and nonliving components of the environment and the interactions that bind them together. Its functioning involves the circulation of matter and energy between organisms and their environment.

Eolian soil material. Soil material accumulated through wind action.

Erodible. Susceptible to erosion. (Expressed by terms such as highly erodible, slightly erodible, etc.)

Erosion surface. A land surface shaped and subdued by the action of erosion, especially by running water. The term is generally applied to a level or nearly level surface.

Escarpment. A long, more or less continuous cliff or relatively steep slope facing in one general direction breaking the general continuity of the land by separating two level or gently sloping surfaces, and produced by erosion or by faulting.

Evaporation. The process by which water is changed from the liquid or solid state into the vapor state.

Evapotranspiration. The process by which water is withdrawn from a land area by evaporation from water surfaces and moist soil and by plant transpiration.

Exotics. An imported floral or faunal species, non-native.

Fault. A surface or zone of rock fracture along which there has been displacement, from a few centimeters to a few kilometers in scale.

Fauna. All animals of a particular period or region, taken collectively.

Fecal coliform. A type of bacteria found in the waste excretions of warm-blooded animals used as the prime indicator of organic fecal pollution.

Feldspar. A group of abundant rock-forming minerals of general formula: $MAl(Al,Si)_3O_8$, where M = K, Na, Ca, Ba, Rb, Sr, and Fe. Feldspars are the most widespread of any mineral group and constitute 60% of the earth's crust; they occur as components of all kinds of rock.

Flora. All plant life of a particular period or region.

Fluviatile deposits. Sedimentary deposits laid down by a river or stream.

Food chain. The pattern of energy or food transfer between a series of organisms interrelated in their feeding habits within an ecosystem. One organism is fed upon by another which in turn is fed upon by another, etc.

Food web. The combination of two or more interconnected food chains.

Forb. Any herbaceous plant other than those that are grass or grass-like.

Foreground. That portion of the visual landscape lying generally from one-quarter to one mile beyond the viewer. Details of human-size features are visible at this distance, and all features are large-scale elements.

Form. The three-dimensional shape of an object or a collection of objects that appear as one.

Formation. A distinctive bed or sequence of rocks selected as a convenient unit for mapping, description, and reference.

Fossil. Any remains, trace, or imprint of a plant or animal that has been preserved by natural processes, in the Earth's crust, since some past geologic time; any evidence of past life.

Fossiliferous. Containing fossilized material.

Frangible. Readily or easily broken.

Friable. Easy to break, crumbling naturally, poorly cemented so as to crumble.

Gaging station. A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or water discharge are obtained. A streamflow gaging station is a gaging station on a stream.

Gallons per minute (gpm). A unit expressing rates of discharge. One cubic foot per second is equal to 448.8 gpm or 646,272 gpd (gallons per day).

Gastropod. Terrestrial or aquatic invertebrate, typically possessing a calcareous, coiled shell, i.e., snail.

Geomorphic. Pertaining to the form of the earth or of its surface features.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification description, nature, origin, and development of present landforms and their relationships to underlying structures, and of the history of geologic changes as recorded by these surface features.

gpd. Gallons per day.

gpm. Gallons per minute.

Graben. An elongate, relatively depressed crustal unit or block that is bounded by faults on its long sides. It is a structural form that may or may not be geomorphologically expressed as a rift valley.

Grade. A degree of inclination, or a rate of ascent or descent, with respect to the horizontal, or a road, railroad, embankment, conduit, or other engineering structure; it is expressed as a ratio (vertical to horizontal), a fraction (such as m/km or ft/mi), or a percentage (of horizontal distance).

Ground water. That part of subsurface water that completely saturates the rocks and is under hydrostatic pressure.

Ground water confined. Confined ground water is under pressure significantly greater than atmospheric, and its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the material in which the confined water occurs.

Ground water, perched. Perched ground water is unconfined ground water separated from an underlying body of ground water by an unsaturated zone. Its water table is a perched water table. It is held up by a perching bed whose permeability is so low that water percolating downward through it is not able to bring water in the underlying unsaturated zone above atmospheric pressure. Perched ground water may be either permanent, where recharge is frequent enough to maintain a saturated zone above the perching bed, or temporary, where intermittent recharge is not great or frequent enough to prevent the perched water from disappearing from time to time as a result of drainage over the edge of or through the perching bed.

Ground water, unconfined. Unconfined ground water is water in an aquifer that has a water table.

Habitat. A specific set of physical conditions that surround the single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Herbivore. Feeds on vegetation.

Herpetofauna. The reptile and amphibian portion of the region's fauna.

Heterotrophic. Obtains food from organic material.

Highwall. The unexcavated face of exposed overburden and coal in a strip mine pit.

Historic site. Any place associated with a significant event, an important person, or a cultural activity of the past. Historic in most cases is 50 years old or older, except for rare instances where exceptional events have taken place, such as the site of the first atom bomb detonation.

Hydrograph. A graph showing stage, flow, velocity, or other property of water with respect to time.

Hardness. A property of water which has generally been associated with the effects observed in the use of soap, or with the deposit left by some types of water when they are heated. Hardness, expressed in terms of an equivalent quantity of calcium carbonate ($CaCO_3$), is calculated from the equivalence of calcium and magnesium, or is determined by direct titration. Hardness caused by calcium and magnesium (and other ions if significant) equivalent to the carbonate and bicarbonate is called carbonate hardness; the hardness in excess of this quantity is called noncarbonate hardness.

Insectivore. Feeds on insects.

In situ. A Latin phrase meaning "in place". Archeologically it refers to an artifact or object found in its original undisturbed position.

Intermittent stream. One which flows part of the time, as after a rainstorm, or during part of the year.

Interspecific tolerance. The degree of tolerance towards members of other species.

Intraspecific tolerance. The degree of tolerance towards others of the same species.

Invertebrate. An animal without a backbone or spinal column.

Ion. An electrified particle formed when a neutral atom or group of atoms loses or gains one or more electrons. If electrons are lost, the particle is positively charged and is called a cation. If electrons are gained, the particle is negatively charged and is called an anion. When a molecule goes into solution, it breaks down into one or more cations and one or more anions. For example, a molecule of the mineral gypsum or calcium sulfate ($CaSO_4$) when dissolved in water disassociates into a calcium ion (Ca^{++}) and a sulfate ion (SO_4^{--}).

Irrigation. The controlled application of water to arable lands to supply water requirements not satisfied by rainfall.

Isopach. A line connecting points of equal or corresponding thickness.

Isopleth. A line connecting points of equal or corresponding values with regard to certain chemical elements.

Jackson Turbidity Unit (JTU). Unit used to measure the turbidity or amount of suspended particulate material carried by a stream.

Joint. A surface of actual or potential fracture or parting in a rock, without displacement; the surface is usually plane and often occurs with parallel joints to form part of a joint set.

Lacustrine. Pertaining to, produced by, or formed in a lake or lakes.

Lagomorph. The taxonomic group of animals that include rabbits, hares, and pikas.

Lake. Any lentic (standing) body of water (e.g., reservoir, pond).

Landform. A discernible natural landscape, such as a floodplain, stream terrace, plateau, valley, etc.

Landscape Visual Unit. Smaller land units into which viewsheds are divided. These distinct now-overlapping units are areas that have differing degrees of visual exposure relative to the viewer. They are defined according to their distance (foreground, middleground, and background) from the viewer, the directions(s) of travel along roads from which they may be viewed, and according to the unique combinations of viewshed sequences providing the view(s).

Landslide. A general term covering a wide variety of mass movement landforms and processes involving the moderately rapid to rapid (on the order of one foot per year or greater) downslope transport, by means of gravitational body stresses of soil and rock material en masse. Usually, but not always, the displaced material moves over a relatively confined zone or surface of shear. The wide range in site variables, structure, and in the material properties affecting resistance to shear, as well as in the factors affecting the driving forces, results in a great range in landslide morphology, rates, and patterns of movement, and in scale. Landsliding is usually preceded, accompanied by, and followed by perceptible creep deformation, along the surface of sliding and/or within the slide mass. Terminology designating particular landslide types generally refers to the landform as well as the process responsible for the landform, e.g., rockfall, talus, translational slide, rockslide, block slide, debris slide, avalanche, earthflow, mudflow, quick clay slide, liquefaction slide, slump, rotational slide, etc.

Leach. To dissolve out by the action of a percolating liquid.

Lentic. Relating to a standing body of water (e.g., ponds, lakes).

Lignite. A brownish-black coal that is intermediate in coalification between peat and subbituminous coal; consolidated coal with a calorific value less than 8300 Btu/pound, on a moist, mineral-matter-free basis.

Limiting factor. A critical living or nonliving element of an ecosystem necessary for an organism to survive that is in the least supply.

Line. Anything arranged in a row or sequence, the silhouette of a form(s), a largely uni-dimensional form, or the intersection of two planes.

Lithic Debris. Cultural material made of stone.

Loess. A widespread, homogeneous, commonly nonstratified, porous, friable, unconsolidated but slightly coherent, usually highly calcareous, fine-grained, blanket deposit of marl or loam, consisting predominantly of silt with subordinate grain sizes ranging from clay to fine sand. Although source and origin is still a controversial question, loess is now generally believed to be windblown dust.

Long ton. A unit of weight that equals 2,240 pounds.

Lotic. Relating to a flowing body of water (e.g., rivers, brooks).

Low, medium, and high flows. Arbitrary designations based on the percentage of time a water discharge was equaled or exceeded. High flows are those greater than a discharge that was equaled or exceeded 20 percent of the time; low flows are those less than a discharge that was equaled or exceeded 80 percent of the time; and medium flows are those greater than a discharge equaled or exceeded 80 percent of the time, but less than a discharge equalled or exceeded 20 percent of the time.

Macrohabitat. General habitat values that are shared by all species of the same order, family, or genus.

Macroinvertebrates. Organisms lacking a spinal cord which inhabit the bottoms of aquatic environments.

Mano. The upper stone used on a metate to grind grains.

Marine. Of, or belonging to, or caused by the sea.

Mesophyte. A plant that grows under intermediate moisture conditions.

Metate. The lower part of a milling stone used to grind grains.

Mg/l. Abbreviation for milligrams per liter, the unit of expression for the concentration of dissolved minerals in water.

Middleground. That portion of the visual landscape lying generally from the limits of foreground to eight miles beyond the viewer. Overall patterns of vegetation and earthform constitute texture which is no longer distinguishable in human-size features.

Minus Deviations. Changes in the natural landscape that do not borrow dominance elements from the characteristic landscape.

Miscellaneous land type. Areas of land that have little or no natural soil or that are too nearly inaccessible for orderly examination, or that occur where for other reasons it is not feasible to classify the soil.

Mollusk. A group of invertebrates that are unjointed and generally enclosed in a shell; such as snails, clams, chitins, and others.

Monocline. A unit of strata that dips or flexes from the horizontal in one direction only, and is not part of an anticline or syncline. It is generally a large feature of gentle dip.

Morainal deposit. An accumulation of unsorted, unstratified, glacial drift.

Mudstone. An indurated mud having the texture and composition, but lacking the fine lamination or fissility, of shale.

Mustelid. Furbearing mammals of the family Mustelifae, such as skunks, weasels, etc.

National Register of Historic Places. A listing maintained by the National Park Service of architectural, historical, archeological, and cultural sites of local, State, or national significance.

Niche. A faunal species function within the ecosystem.

Normal fault. A fault in which the hanging wall appears to have moved downward relative to the footwall. The angle of the fault is usually 45-90°.

Ocher. An iron rich clay, ranging in color from yellow to brown, used as a pigment.

Omnivore. A nonselective feeder, feeds on both plant and animal material.

Overburden. All the earth and other materials which lie above a natural deposit of minerals.

Oxbow lake. The crescent-shaped, often ephemeral, body of standing water situated by the side of a stream in the abandoned channel (oxbow) of a meander after the stream formed a neck cutoff and the ends of the original bend were silted up.

Paleontology. The study of life in past geologic periods, based on fossil plants and animals and including phylogeny, their relationships to existing plants and animals, and the chronology of the earth's history.

Paludal. Pertaining to swamps or marshes, and to material deposited in a swamp environment.

Parts per million (ppm). A unit for expressing concentration of dissolved solids and sediment. A part per million of dissolved solids is a unit weight of dissolved solids in a million unit weights of a water-dissolved solids solution. A part per million of sediment is a unit weight of sediment in a million unit weights of water-sediment mixture.

Pelecypod. Bivalved aquatic invertebrate.

Percent sodium. The ration, expressed in percentage, of equivalents per million of sodium ions to the sum of equivalents per million of calcium, magnesium, sodium, and potassium ions.

Perennial stream. One which flows continuously from source to mouth during most years.

Permeability. (1) The quality of a soil horizon that enables water or air to move through it. (2) The property or capacity of a porous rock sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it.

(pH) Hydrogen-ion concentration. The negative logarithm of the concentration of hydrogen ions. The pH is a measure of the activity of the hydrogen ions and thus is a numerical value or measure of the alkalinity or acidity of the water. Ordinarily, water having a pH of 7.0 is regarded as neutral; a pH lower than 7.0 indicates acidic properties; and a pH higher than 7.0 indicates alkalinity. However, a water that is acid, alkaline, or neutral according to the pH scale is not necessarily the same by another standard.

Physical properties (of soils). Those characteristics, processes, or reactions of a soil which are caused by physical forces and which can be described by, or expressed in, physical terms or equations.

Plus Deviations. Changes in the natural landscape that borrow dominance elements from the characteristic landscape.

Porosity. The property of a rock, soil, or other material containing interstices. It is commonly expressed as a percentage of the bulk volume of material occupied by interstices, whether isolated or connected.

Precipitation. The discharge of water, in liquid or solid state, out of the atmosphere, generally upon land or water surface. The term is also used to designate the quantity of water that is precipitated.

Primary consumer. Heterotrophic organisms that feed directly on producers.

Producer. Autotrophic organisms, largely green plants, which are able to manufacture food from simple inorganic substances.

Protists. A group of unicellular organisms, such as bacteria and slime molds, which are often considered to form a third kingdom, distinct from the plant and animal kingdoms.

R. Range, one of the north-south rows of townships in a U.S. public-land survey.(Plural: Rs.)

Rainfall. The quantity of water that falls as rain only. The term is not synonymous with precipitation.

Range. The area occupied by a given species for all or a portion of their lives.

Raptor. Birds of prey with sharp talons and strong notched beaks: hawks, owls, vultures, etc.

Recharge. The process by which water moves into an aquifer, or the amount of water that moves into an aquifer.

Reclamation. The process of returning resource values to lands affected by controlled land disturbances to a form and productivity consistent with a stated land use plan which includes a stable ecological state, is compatible with the values of the surrounding lands, and is executed on lands which are fully capable of supporting the uses or higher or better uses which they were capable of supporting prior to disturbance.

Controlled land disturbance. Including mining, oil and gas recovery, access roads, powerlines, pipelines, and any other activities which alter the original ground surface and the resources (either surface or subsurface), and require prior approval by the regulatory authority.

Recreation Capability Classification. A rating of the land's natural capability to both attract and sustain recreational use, irrespective of location, present access, and potential management applications.

Rehabilitation. The process of returning resource values to lands affected by uncontrolled land disturbances to a form and productivity consistent with a stated land use plan which includes a stable ecological state.

Uncontrolled land disturbance. Includes fire, floods, landslides, earthquakes, or other types of disturbances arising from natural causes, catastrophic occurrences, or uncontrolled human activity, which usually results in the destruction or degradation of the resource values on the lands affected.

Reserves. Known deposits of coal that can be profitably mined. Tonnage generally known within 20 percent.

Residual material. Unconsolidated or partly weathered parent material of a soil, presumed to have developed in place (by weathering) from the consolidated rock on which it lies; it is the material from which soils are formed.

Residual sodium carbonate (RSC). The amount of carbonate plus bicarbonate, expressed in equivalents per million, that would remain in solution if all the calcium and magnesium were precipitated as carbonate.

$$RSC+(CO_3+HCO_3)-(Ca+Mg)$$

Resources. Includes reserves and other coal deposits that may become profitable to mine. Tonnage imperfectly known.

Restoration, soil. Returned to the original condition.

Return flow. The water returned to the stream system or source after being used. Return flow is generally equal to water use less consumptive use.

Riparian. Situated on or pertaining to the bank of a river, stream, or other body of water.

Riprap. A layer of large, durable, dense, specially selected and graded, broken rock fragments thrown together irregularly (as in deep water or on a soft bottom) to prevent erosion, through wave action or strong currents, and thereby preserve the shape of a surface, slope, or underlying structure. It is used for irrigation channels, river-improvement works, spillways at dams, and shore protection.

Rough broken land. Land with very steep topography and numerous intermittent drainage channels, but usually covered with vegetation.

Runoff. That part of the precipitation that appears in surface streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man, in or on the stream channels or on the drainage area.

Saline-alkali soil. A soil containing sufficient exchangeable sodium to interfere with the growth of most crop plants, and containing appreciable quantities of soluble salts.

Saline soil. A nonalkali soil containing sufficient soluble salts to impair its productivity but not containing excessive exchangeable sodium.

Sand. A rock fragment or detrital particle smaller than a granule and larger than a coarse silt grain, having a diameter in the range of 1/16 to 2 mm (62-2000 microns, or 0.0025-0.08 in., or 4 to -1 phi units.)

Sandstone. A medium-grained, clastic sedimentary rock composed of abundant and rounded or angular fragments of sand size set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate); the consolidated equivalent of sand.

Saturated zone. That part of water-bearing material in which all voids, large and small, are filled with water under pressure greater than atmospheric.

Scarp. A line of cliffs or steep slopes produced by faulting or by erosion. The term is an abbreviated form of escarpment, and the two terms commonly have the same meaning, although "scarp" is more often applied to cliffs formed by faulting.

Scraper. A stone implement used to scrape leather, smooth wood, etc.

Sec. Section; a parcel of land that is one square mile or 640 acres. (Plural: Secs.)

Secondary consumer. Heterotrophic organisms that feed on other heterotrophs.

Sediment. Fragmented material that originates mostly from rocks and is transported by, suspended in, or deposited from water or air.

Sedimentation. The process by which the turbidity of a stream is increased by the passage of sediment.

Sediment discharge. (1) the rate at which dry weight of sediment passes a section of a stream, or (2) the quantity of sediment, as measured by dry weight or by volume, that is discharged in a given time.

Sediment station. A particular site on a stream, canal, or other waterway where a record of sediment discharge is obtained.

Sediment yield. A unit for expressing the discharge of dissolved solids or sediment from an area. Sediment yield and dissolved-solids yield is usually given in tons per square mile per year.

Semiarid. A term applied to regions or climates where moisture is normally greater than under arid conditions, but still definitely limits the growth of most crops.

Shale. A fine-grained, indurated, detrital sedimentary rock formed by the consolidation (as by compression or cementation) of clay, silt, or mud, and characterized by finely stratified (laminae 0.1-0.4 mm thick) structure and/or fissility that is approximately parallel to the bedding (along which the rock breaks readily into thin layers), and that is commonly most conspicuous on weathered surfaces, and by a composition with an appreciable content of clay minerals or derivatives from clay minerals, and with a high content of detrital quartz.

Sherd. A broken piece of a pottery vessel.

Short ton. A unit of weight that equals 2,000 pounds.

Sill. An intrusive body of igneous rock of approximately uniform thickness, and relatively thin compared with its lateral extent, which has been emplaced parallel to the bedding of the intruded rocks.

Silt. (soil) A soil-texture term used in the U.S. for a rock or mineral particle in the soil, having a diameter in the range of 0.02-0.05 mm; prior to 1937, the range was 0.005-0.05 mm. The diameter range recognized by the International Society of Soil Science is 0.002-0.02 mms.

Siltstone. An indurated or somewhat indurated silt having texture and composition, but lacking the fine lamination or fissility, of shale.

Slump. (1) Material that has slid down from high rock slopes. (2) The downward slipping of a mass of rock or unconsolidated material of any size, moving as a unit or as several subsidiary units, usually with backward rotation on a more or less horizontal axis parallel to the cliff or slope from which it descends.

Slurry. A mixture of fine coal in water. Commonly pumped through pipelines at processing plants or to consumption points.

Social Support Facilities. Those facilities necessary for the existence of a town such as schools, roads, medical services, and facilities normally supported by public funds.

Sodium-absorption-ratio (SAR). Related to the absorption of sodium by the soil and is an index of the sodium, or alkali, hazard of the water. In the computation of SAR, concentrations of constituents are in equivalents per million.

$$SAR=\frac{Na+}{\sqrt{\frac{Ca{+}{+} + Mg{+}{+}}{2}}}$$

Soil association. A mapping unit used on general soil maps in which two or more defined taxonomic units occurring together in a characteristic patter are combined on the map into one unit. The components of the soil association may or may not be contrasting.

Soil material. Soils leached free of soluble salts and capable of sustaining plant growth, and recognized as such by standard authorities.

Soil series. A group of soils having horizons similar in characteristics and arrangement in the soil profile, except for texture of the surface portion.

Specific conductance. A measure of the capacity of a solution to conduct an electrical current, expressed in micromhos per centimeter at 25°C. It is one million times the reciprocal of specific resistance at 25°C. Specific resistance is the resistance in ohms of a column of water one centimeter long and one square centimeter in cross section. Because the specific conductance is related to the number and specific chemical types of ions in solution, it can be used for approximating the salinity of the water.

Spoil. The overburden removed in strip mining. Debris or waste material from a strip mine.

Stratigraphic trap. The sealing of a reservoir bed as the result of lithologic changes rather than through structural trapping conditions.

Stratigraphic unit. A stratum or body of strata recognized as a unit in the classification of the rocks of the earth's crust with respect to any specific rock character, property, or attribute or for any purpose such as description, mapping, and correlation.

Stratigraphy. The branch of geology that deals with the definition and description of major and minor natural divisons of rocks (mainly sedimentary, but not excluding igneous and metamorphic) available for study in outcrop or from subsurface. It involves interpretation of these features of rock strata in terms of their origin, occurrence, environment, thickness, lithology, composition, fossil content, age, history, paleogeographic conditions, relation to organic evolution, and relation to other geologic concepts.

Stratum. A tabular or sheet-like mass, or a single and distinct layer, of homogeneous or gradational sedimentary material (consolidated rock or unconsolidated earth) of any thickness, visually separable from other layers above and below by a discrete change in the character of the material deposited, or by a sharp physical break in deposition, or by both; a sedimentary bed. (Plural: Strata.)

Stream. Any lotic (flowing) body of water (e.g., brooks, rivers).

Streamflow. The water discharge that occurs in a natural channel, whether or not the water discharge is affected by regulation or underflow.

Strike. The direction or trend that a structural surface, e.g. a bedding or fault plane, takes as it intersects the horizontal.

Structural trap. The containment of oil or gas within a reservoir bed as the result of flexure or fracture.

Subbituminous coal. Nonagglomerating coal having a heat value of 8,300 to 13,000 Btu on a moist, mineral-matter-free basis. Intermediate in rank between lignite and bituminous coal.

Succession. The progressive development of vegetation toward its highest ecological expression, the climax; replacement of one plant community by another.

Suspended sediment. Sediment that is supported by the upward components of turbulent currents, or by colloidal suspension if the sediment particles are very small.

Synecology. Deals with the study of groups of organisms which are associated together as a unit.

T. Township, a tract of land that is bounded on the east and west by meridians six miles apart at its south border, has a north-south length of six miles, and forms one of the chief divisions of a U.S. public-land survey. (Plural: Tps.)

Talus. (1) Talus slope. (2) Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep, rocky slope.

Temperature inversion. A layer in which temperature increases with altitude. The principal characteristic of an inversion layer is its marked static stability, within which very little turbulent exchange can occur.

Terrace. Any long, narrow, relatively level or gently inclined surface, generally less broad than a plain, bounded along one edge by a steeper descending slope and along the other by a steeper ascending slope.

Terrestrial. Consisting of or pertaining to the land in distinction from water.

Terrestrial deposit. (1) A sedimentary deposit laid down on land above tidal reach, as opposed to a marine deposit. (2) Strictly, a sedimentary deposit laid down on land as opposed to one resulting from the action of water.

Texture. The visual arrangement of the parts of a landscape feature. What constitutes texture depends on the object's distance from the viewer; the dominant texture of trees, for example, is leaves or boughs in the foreground, individual trees or groves in the middleground, and forests in the background.

Thrust fault. A fault with a dip of 45° or less in which the hanging wall appears to have moved upward relative to the footwall. Horizontal compression rather than vertical displacement is its characteristic feature.

Tons per day. A unit commonly used for expressing discharge of dissolved solids and sediment.

Tons per square mile per year. A unit for expressing the discharge of dissolved solids or sediment from an area. Sediment yield and dissolved-solids yield is usually given in tons per square mile per year.

Topsoil. Natural earth materials at or adjacent to the land surface, with physical and chemical characteristics necessary to support vegetation.

Total dissolved solids (TDS). The dissolved mineral constituents of water.

Transpiration. The process by which water moves from living plants to the atmosphere.

Trophic level. Energy level where those organisms with similar feeding habits are grouped together, as in an energy pyramid.

Turbidity. The measure of the degree of light penetration produced in water by materials suspended in the water.

Unit train. A train made up entirely of coal cars carrying coal directly from the loading place to point of delivery.

Upland. (1) The higher ground of a region, in contrast with a valley, plain, or other low-lying land, a plateau. (2) The elevated land above the low areas along a stream.

Use (water). The total quantity of water pumped, diverted, applied, or utilized for any purpose.

Vertebrate. An animal having a backbone or spinal column.

Viewshed. A land unit bounded by topographic features that define the limits of views from within the unit. Adjacent viewsheds may share common topographic boundaries, or they may overlap if portions are visible from more than the unit's one viewshed sequence.

Viewshed Sequence. A road segment contained by a viewshed; a new viewshed sequence begins when the road enters a new or overlapping viewshed.

Viewshed Sequence Points. The points on a road where one viewshed sequence ends and another begins.

Visitor day. Participation in an outdoor recreation activity by one user or a combination of users that is equivalent to one 12-hour recreation visit.

Visual Dominance Elements. The four "building blocks" of the visual landscape that can be used to describe what is seen: form, line, color, and texture.

Water discharge. The flow of a stream or canal, outflow from a basin, or flow of water from a pipe. Water discharge includes the sediment mixed with and solids dissolved in the water.

Water table. The water table is that surface in an unconfined water body at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water. In wells which penetrate to greater depths, the water level will stand above or below the water table if an upward or downward component of ground-water flow exists.

Water type. A term used to denote the predominate cations and anions in water. Whether certain cations (calcium, magnesium, sodium, and potassium), and certain anions (bicarbonate, sulfate, and chloride), predominate depends on the concentrations in equivalents per million and the relation of the concentration of the individual ions to each other. For example, if the concentration of sodium makes up most of the total cations, and the concentration of bicarbonate makes up most of the total anions, the water is classified as a sodium bicarbonate type. However, if the second most abundant cation or anion is more than half the most abundant cation or anion, and the third most abundant cation or anion is more than half the second, they are included in the water-type classification in order of magnitude. Examples of these more complex water types would be calcium magnesium bicarbonate, calcium magnesium bicarbonate sulfate, and sodium magnesium calcium chloride sulfate.

Water year. The 12-month period October 1 through September 30 of the following calendar year. The water year is designated by the calendar year in which it ends.

Water yield. The runoff from a drainage basin.

Weighted-average concentration. A discharge-weighted average that approximated the dissolved-solids concentration of water that would be found in a reservoir containing all the water passing a given station during a specified period after thorough mixing in the reservoir. The effects of evaporation, precipitation, or the addition or removal of dissolved constituents by plants or animals is not considered in this definition.

Wind rose. A diagram designed to show the distribution of wind direction recorded at a given location over a period of time.

Working pit. The place at a mine from which coal is actually being extracted.

Appendix D

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COAL LEASES C-081330
C-0128433
C-052547 (originally issued to
Thomas P. Greenhalgh)

OF

ENERGY FUELS CORPORATION

(Morgan Coal Company currently lessor of all three leases has appointed Energy Fuels Corporation the Designated Operator.)

FILE
JM

Form 4–696
(July 1963)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
910 - 15th St., Denver, Colorado
Preference-right COAL LEASE
Act of February 25, 1920 (41 Stat. 437), as amended

ORIGINAL
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
1963 NOV 12 PM 12

Land Office
Colorado

Serial Number
C-081330

This lease, entered into on **NOV 1 1963** , 19 , by the United States of America, the lessor, through th
Bureau of Land Management, and **Morgan Coal Company**
2850 North Meridian Street
Indianapolis, Indiana

the lessee, pursuant and subject to the terms and provisions of the Act of February 25, 1920 (41 Stat. 437), as a-mended, hereinafter referred to as the Act, and to all reasonable regulations of the Secretary of the Interior now in force which are made a part hereof,

WITNESSETH:

Sec. 1. *Rights of lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of **Colorado**

T. 4 N., R. 86 W., 6th P.M.
Section 8: Lots 1,2,3, SE¼
Section 9: N½SW¼
Section 17: NE¼, NW¼SE¼, W½
Section 18: E½, Lot 8

F
T. 5 N., R. 86 W., 6th P.M.
Section 20: S½
Section 21: SW¼
Section 28: W½NW¼, E½SW¼
Section 29: NE¼
Section 33: W½NE¼, NE¼NW¼

containing **2175.28** acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privi-leges herein granted.

*** (See attached sheet)**

Sec. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) *Bond.* To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount or furnish such other bond as may be required.

(b) *Rental.* To pay the lessor annually, in advance, for each acre or part thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year, 50 cents for the second, third, fourth, and fifth years, respectively, and $1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

*(c) *Royalty.* To pay the lessor a royalty of cents
lessee snall pay a royalty, less rent, on such minimum amount

on every ton of 2,000 pounds of coal mined during the firs 20 years succeeding the execution of this lease. Royaltie shall be payable quarterly within 30 days from the expiratio of the quarter in which the coal is mined.

(d) *Minimum production.* Beginning with the sixth year c the lease, except when operations are interrupted by strikes the elements, or casualties not attributable to the lessee, c unless on application and showing made, operations shall b suspended when market conditions are such that the lesse cannot operate except at a loss or suspended for the othe reasons specified in Section 39 of the Act, to mine coal eac year and pay a royalty thereon to a value of $1 per acre c fraction thereof. Operations under this lease shall be contir uous except in the circumstances described or unless th lessee shall pay a royalty, less rent, on such minimum amoun of the leased deposits, for one year in advance, in whicl case operations may be suspended for that year.

) *Payments.* To make rental payments to the Manager e appropriate Land Office, except that when this lease nes productive the rentals and royalties shall be paid e appropriate Regional Mining Supervisor of the United s Geological Survey, with whom all reports concerning tions under the lease shall be filed. All remittances to lanager of the Land Office shall be made payable to the au of Land Management, those to the Geological Survey be made payable to the United States Geological Survey.

) *Plats, reports, maps.* At such times and in such form ie lessor may prescribe, to furnish a plat showing de- ment work and improvements on the leased lands and a t with respect to stockholders, investment, depreciation. costs. To furnish in such form as the lessor may pre- e, within 30 days from the expiration of each quarter a covering such quarter, certified by the superintendent mine, or by such other agent having personal knowledge facts as may be designated by the lessee for such pur- showing the amount of leased deposits mined during the er, the character and quality thereof, amount of its prod- and byproducts disposed of and price received therefor, mount in storage or held for sale. To keep and prepare of the leased lands in accordance with the regulations CFR, Part 211.

) *Weights.* To determine accurately the weight or ity and quality of all leased deposits mined, and to enter ately the weight or quantity and quality thereof in due in books to be kept and preserved by the lessee for such ses.

) *Inspection.* To permit at all reasonable times (1) in- ion by any duly authorized officer of the Department, of eased premises and all surface and underground improve- , works, machinery, equipment, and all books and records ining to operations and surveys or investigations under lease; and (2) the lessor to make copies of and extracts any or all books and records pertaining to operations this lease, if desired.

) *Assignment.* To file for approval in the appropriate Office within 90 days from the date of execution, any nment or transfer made of this lease, whether by direct nment, operating agreement, working or royalty interest, erwise. Such instrument will take effect the first day of nonth following its approval by the Bureau of Land gement, or if the assignee requests, the first day of the of approval. The showing required to be made with an nment or transfer is set forth in the regulations, R 193.25.

) *Nondiscrimination clauses.* In connection with the rmance of work under this contract, the lessee agrees llows:

(1) The lessee will not discriminate against any oyee or applicant for employment because of race, creed, , or national origin. The lessee will take affirmative n to ensure that applicants are employed, and that em- es are treated during employment, without regard to their creed, color, or national origin. Such action shall de, but not be limited to, the following: employment, ding, demotion or transfer; recruitment or recruitment tising; layoff or termination; rates of pay or other forms ompensation; and selection for training, including ap- iceship. The lessee agrees to post in conspicuous s, available to employees and applicants for employment, es to be provided by the contracting officer setting forth ovisions of this nondiscrimination clause.

(2) The lessee will, in all solicitations or adver- ents for employees placed by or on behalf of the lessee, that all qualified applicants will receive consideration nployment without regard to race, creed, color, or national .

(3) The lessee will send to each labor union or sentative of workers with which he has a collective ining agreement or other contract or understanding, a e, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the lessee's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The lessee will comply with all provisions of Executive Order No. 10925 of March 6, 1961, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The lessee will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the lessee's noncompliance with the nondiscrimination clause of this contract or with any of the said rules, regulations, or orders, this lease may be canceled in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The lessee will include the provisions of the foregoing paragraphs (1) through (6) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order No. 10925 of March 6, 1961, so that such provisions will be binding upon each subcontractor or vendor. The lessee will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the lessee becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

NOTE TO CONTRACTOR — (Additional requirement for subcontracts with the Department of the Interior) — In compliance with the Rules and Regulations (41 CFR, Section 60—1.3(a)) issued under Executive Order 10925 of March 6, 1961, the prime contractor is hereby bound and agrees to include in each subcontract which it shall make with a subcontractor or supplier paragraphs (1) through (7) of Section 301 of said Executive Order (as quoted above), unless exempted pursuant to the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity.

(k) *Land disposed of with coal deposits reserved to the United States.* If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) *Operations, wages, freedom of purchase.* To comply with the operating regulations (30 CFR, Part 211), to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman,

(c) Royalty (continued). To pay the lessor a royalty of 15 cents on every ton of 2,000 pounds mined by underground methods and 17½ cents a ton for coal mined by stripping or surface auger methods during the first 20 years succeeding the execution of this lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) *Taxes.* To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) *Overriding royalties.* Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) *Delivery of premises in case of forfeiture.* In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) *Rights reserved.* The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) *Disposition of surface.* The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) *Monopoly and fair prices.* Full power and authority to promulgate and enforce all the provisions of Section 30 of the Act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) *Readjustment of terms.* The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) *Waiver of conditions.* The right to waive any breach of the conditions contained herein, except the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. *Relinquishment of lease.* Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment *must* be filed in *duplicate* in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improvements on the leased lands in accordance with the regulations and terms of the lease.

Sec. 5. *Protection of the surface, natural resources, and improvements.* The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) Causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. *Removal of equipment, etc., on termination of lease.* Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, except underground timbering placed by the lessee in or on the leased lands, which are necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. *Proceedings in case of default.* If the lessee shall not comply with any of the provisions of the Act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the Act (30 USC, Sec. 188). If the lessee fails to take prompt and necessary steps to prevent loss of damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necdssary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. *Heirs and successors in interest.* Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. *Unlawful interest.* No Member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom; and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 USC, Sec. 22), and Sections 431, 432, and 433, Title 18, U. S. C., relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA

By Iola M Clark
(Signing Officer)

CHIEF, MINERAL ADJUDICATION SECTION
(Title)

NOV 1 4 1963
(Date)

WITNESSES TO SIGNATURE OF LESSEE

Miller E. Spears

MORGAN COAL COMPANY

By
(Signature of Lessee)
Harrison Eiteljorg, Managing Partner

(Signature of Lessee)

(Signature of Lessee)

(If this lease is executed by a corporation, it must bear the corporate seal)

NONDISCRIMINATION IN EMPLOYMENT

THIS CONTRACT (LEASE, LICENSE, PERMIT) IS SUBJECT TO THE PROVISIONS OF SEC. 301 OF EXECUTIVE ORDER NO. 10925, A COPY OF WHICH IS ATTACHED.

GPO 835-357

Form 4–1634
(April 1962)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NONDISCRIMINATION IN EMPLOYMENT

In connection with the performance of work under this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The Contractor will send to each labor union or representative of workers with which he has a collective-bargaining agreement or other contract or understanding, a notice, to be provided by the agency Contracting Officer, advising the said labor union or workers' representative of the Contractor's commitments under this nondiscrimination clause, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Contractor will comply with all provisions of Executive Order No. 10925 of March 6, 1961, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The Contractor will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Contractor's noncompliance with the nondiscrimination clause of this contract or with any of the said rules, regulations, or orders, this contract may be canceled in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The Contractor will include the provisions of the foregoing paragraphs (1) through (6) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to section 303 of Executive Order No. 10925 of March 6, 1961, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

NOTE TO CONTRACTOR

Additional requirement for subcontracts with the Department of the Interior.

In compliance with the Rules and Regulations (41 CFR, section 60–1.3(a)) issued under Executive Order 10925 of March 6, 1961, the prime contractor is hereby bound and agrees to include in each subcontract which it shall make with a subcontractor or supplier paragraphs (1) through (7) of section 301 of said Executive Order (as quoted above), unless exempted pursuant to the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity.

GPO 855220

GPO 832077

PREFERENCE RIGHT COAL LEASE

This lease, entered into on June 1, 1975, by the United States of America, the Lessor, through the Bureau of Land Management, and

Morgan Coal Company
4567 Cold Spring Road
Indianapolis, Indiana 46208

, The Lessee,

pursuant and subject to the terms and provisions of the act of February 25, 1920, 41 Stat. 437 as amended, 30 U.S.C. § § 181-263, and to all regulations (including, but not limited to, 30 CFR Part 211 and 43 CFR Parts 23 and 3500) of the Secretary of the Interior now or hereafter in force which are made a part hereof,

WITNESSETH:

Sec. 1. Rights of Lessee. The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the Lessee the exclusive right and privilege to mine and dispose of all the Coal in the following-described tracts of land, situated in the State of Colorado:

T. 5 N., R. 86 W., 6th P.M. (Routt County)
Section 19: Lot 8, SE¼SW¼, S½SE¼
Section 30: Lots 1, 2, 3, 4, E½W½

containing 474.93 acres, more or less, together with the right to construct all works, buildings, structures, and appliances as may be necessary and convenient for the mining and preparation of the Coal for market and, subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Sec. 2. Definitions. (a) "Act" means the Mineral Leasing Act of February 25, 1920, 41 Stat. 437 as amended, 30 U.S.C. § § 181-263;

(b) "Anniversary Date" means the anniversary of the Effective Date of this lease;

(c) "Bureau" means the Bureau of Land Management;

(d) "Coal" means all ranks of coal from lignite to anthracite;

(e) "District Manager" means the manager of the district office or other authorized officer of the Bureau having administrative jurisdiction of or responsibility for the Leased Lands;

(f) "Effective Date" is June 1, 1975.

(g) "Geological Survey" means the United States Geological Survey;

(h) "Leased Lands" means the tracts described in section 1 of this Lease;

(i) "Lease Year" means the period of time between two successive Anniversary Dates of this Lease;

(j) "Lease Month" means the period of time between the day of any calendar month corresponding to the day of the month which is the Anniversary Date, and the same day of the first succeeding calendar month;

(k) "Mining Supervisor" means the area mining supervisor of the Conservation Division of the Geological Survey;

(l) "Ton" means a measure of weight of 2,000 pounds avoirdupois.

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Sec. 3. Bond. The Lessee shall file with the appropriate Bureau office a $55,000 lease bond payable to the United States Department of the Interior, effective on the Effective Date, to insure payment of rentals and royalties on an annual basis, to insure compliance with the Environmental Stipulations incorporated into this Lease, and to insure compliance with all other terms of the Lease. An increase in the amount of the bond may be required by the Mining Supervisor upon approval of the exploration or mining plan required under sections 10 and 11 of this Lease, or upon approval of a change in either plan, or at any other time during the life of the Lease to reflect changed conditions. Notwithstanding anything contained in this section to the contrary, the Lessee may, in lieu of the bond herein described, post cash or negotiable United States Government Securities in the amount of the bond required, provided however that at all times the market value of said United States Government Securities, if posted, shall be at least equal to the sum of the bond required.

Sec. 4. Annual Advance Rental. (a) An annual rental, payable in advance, of $3.00 for each acre or fraction thereof covered by this Lease shall be due on the Effective Date and on each Anniversary Date hereafter. The rental shall be subject to section 39 of the Act (30 U.S.C. § 209), and for each year the rental shall be creditable against any production and advance royalties for that year as they accrue under this Lease.

Sec. 5. Production Royalty. (a) A production royalty of 8% of the gross value of coal produced; but not less than 40 cents per ton of 2,000 pounds, shall be due on coal extracted by the lessee from the leased lands.

(b) The Lessee agrees that the Lessor shall determine the gross value of the Coal produced from the Leased Lands for the purpose of Subsection 5(a) as follows:

(1) The gross value shall be considered to be the price received by the Lessee, adjusted for transportation and/or processing costs so that it is a measure of the value of the Coal at the mine mouth as designated or specified by the Area Mining Supervisor (or in the case of strip mining that point where the Coal is delivered from the pit): provided, that where it appears to the Lessor that a contract or other business arrangement between the Lessee and a purchaser of some or all of the Coal is not a bona fide transaction between independent parties, or where it appears to the Lessor that there is no price received for some or all of the Coal by the Lessee because the Lessee is consuming the Coal for his own use or adding it to inventories, the Lessor shall determine the value of such Coal produced by the Lessee by giving due consideration to: (A) the price received by the Lessee, (B) the highest price paid for a part or a majority of the production of Coal of like quality produced from the same general area during the Lease Month, (C) contracts or other business arrangements between Coal producers and customers for the sale of Coal, other than those involving sales of Coal produced under this Lease, which are comparable with respect to term, volume, time of execution, area of supply and other circumstances, and (D) other relevant factors.

(2) The Lessee agrees to supply any and all relevant information requested by the Lessor to aid in the decision as to whether the price received by the Lessee will be the gross value of the Coal produced. Such information shall include, but shall not be limited to, copies of contracts for the sale of Coal produced and evidence of legal relationships, if any, between the Lessee and his customers.

Sec. 6. Advance Royalty. (a) An advance royalty shall be due monthly at the rate set forth in subsection 5(a) based upon the following annual production rates: 10,100 Tons per Lease Month for the sixth Lease Year; 15,200 Tons per Lease Month for the seventh Lease Year: 20,200 Tons per Lease Month for the eighth Lease Year; 25,300 Tons per Lease Month for the ninth Lease Year; and 30,300 Tons per Lease Month for the tenth and each succeeding Lease Year.

(b) The Lessee agrees that the Lessor shall determine the gross value of Coal for the purpose of subsection 6(a) as follows:

(1) If during the Lease Month Coal is being produced from the Leased Lands, the gross value per Ton of the Coal for advance royalty purposes for that month shall be the weighted average of the gross value for such Coal for that month as determined for production royalty purposes under subsection 5(b).

(2) If during the Lease Month no Coal is produced from the Leased Lands, but in previous Lease Months Coal has been produced from the Leased Lands, the gross value per Ton of the Coal for advance royalty purposes shall be the weighted average of the gross value of the Coal produced in the most recent Lease Month in which Coal was produced from the Leased Lands as determined for production royalty purposes under subsection 5(b), raised or lowered in the same proportion as the Bureau of Labor Statistics Monthly Wholesale Price Index for bituminous coal has risen or fallen since the most recent Lease Month in which Coal was produced from the Leased Lands and the most recent month for which said price index has been published.

(3) If no Coal has ever been produced from the Leased Lands, the gross value of the Coal for advance royalty purposes in any Lease Month will be equal to $10.00 per ton, raised or lowered in the same proportion as the Bureau of Labor Statistics Monthly Wholesale Price Index for bituminous coal has risen or fallen between its level of 389.6 in May 1975 and its level in the most recent month for which said price index has been published.

(4) If for any reason in the judgment of the Lessor the Bureau of Labor Statistics Monthly Wholesale Price Index for bituminous coal becomes unavailable or inappropriate for the purpose of this subsection, the Lessee hereby agrees that the Lessor may, after consultation with the Lessee, substitute another index reasonably suited to the purpose of the subsection.

Sec. 7. Total Royalty Payments. (a) For any Lease Month, the total royalty payment, if any, shall be equal to the greater of:

(1) the excess of total advance royalty due from the Effective Date to and including the current Lease Month over the total royalty payments due (before the advance rental deduction) from the Effective Date to and including the Lease Month preceeding the current Lease Month, or

(2) the excess of total production royalty due from the Effective Date to and including the current Lease Month over the total royalty payments due (before the advance rental deduction) from the Effective Date to and including the Lease Month immediately preceding the current Lease Month less one-twelfth of the annual advance rental.

(b) For any Lease Month, the total royalty payment shall be payable by the final day of the third succeeding Lease Month.

(c) No refund and no credit, other than that against future production royalties, for advance royalty payments shall be made by lessor.

Sec. 8. Minimum Production. The Lessee shall produce Coal from the Leased lands in accordance with the mining plan required by section 11 of this Lease, except that the Mining Supervisor may suspend the production requirements in that plan when, in accordance with section 39 of the Act (30 U.S.C. § 209), he determines that it is in the interest of conservation, or when, in accordance with section 7 of the Act (30 U.S.C. § 207), the lessee files an application for suspension of the production requirements which shows to the satisfaction of the Mining Supervisor that operations are interrupted by strikes, the elements, or occurrences not attributable to the Lessee.

Sec. 9. Method of Payments. The Lessee shall make rental payments to the appropriate Bureau office until the first production or advance royalty payments are due. At that time, all rentals and production and advance royalties shall be paid to the Mining Supervisor with whom all reports concerning operations under the Lease shall be filed. All remittances to the Bureau shall be made payable to the Bureau of Land Management; those to the Geological Survey shall be made payable to the United States Geological Survey.

Sec. 10. Exploration Plan. (a) Prior to undertaking any exploratory work on the Leased Lands between the Effective Date and the date of approval of the mining plan required under section 11 of this Lease, the Lessee shall file with the Mining Supervisor an exploration plan in accordance with the provisions of 30 CFR Part 211 and 43 CFR Part 23, showing the exploratory work and reclamation measures following such work which he proposes, and he shall not commence that work until the Mining Supervisor has approved the exploration plan. After approval of the exploration plan, the Lessee shall conduct all exploratory work in accordance with the plan.

(b) Not less than 30 days after consulting with the Lessee, the Mining Supervisor may reasonably change or supplement the exploration plan at any time to be consistent with amended Environmental Stipulations or to adjust to changed conditions or to correct an oversight. If the Lessee seeks to obtain approval of a changed or supplemental plan, he shall submit a written statement of the proposed change or supplement and the justification for the proposed change or supplement. Within 30 days after receiving the written statement from the Lessee, the Mining Supervisor shall, in writing, approve or disapprove the proposed change or supplement, unless he shall advise the Lessee of compelling and valid reasons, requiring more than 30 days to make a decision. In no event shall proposed changes or supplements be effective unless the Mining Supervisor approves of them in writing.

(c) Exploratory work, as used in this section, shall include, but not be limited to, seismic work, drilling, blasting, research operations, cross-country travel, the construction of roads and trails and other necessary facilities required under the Environmental Stipulations incorporated in this Lease.

(d) The requirement under this section may be waived upon approval of the Mining Supervisor with concurrence of the District Manager, if the requirements of exploration have been met at the date of issuance of the lease.

Sec. 11. Mining Plan. (a) The Lessee shall file in sextuplicate with the Mining Supervisor on or before the third Anniversary Date a detailed development, production and reclamation plan in accordance with the provisions of 30 CFR Part 211 and 43 CFR Part 23. The plan is referred to in this Lease as the "mining plan". The plan shall include: (1) a schedule of further planning and exploratory operations, the development, production, processing, and reclamation operations and other activities to be conducted under this

Lease: (2) a detailed description of the procedures to be followed to assure that all operations will meet and conform with the Environmental Stipulations incorporated in the Lease; and (3) a showing that the Lessee will use all due diligence (A) to extract all Coal in the Leased Lands which can be safely recovered by approved mining methods consistent with the protection and use of other natural resources and with sound economic practice and (B) to attain production from the Leased Lands at a rate at least equal to the rate on which advance royalty for this Lease is computed.

(b) Prior to commencing any operations under the mining plan, the Lessee shall obtain the Mining Supervisor's approval of the plan. The Mining Supervisor shall not delay unnecessarily in the consideration of a plan, but he shall take time to consider both technical and environmental provisions of the plan thoroughly prior to approval. If the plan submitted by the Lessee is unacceptable, the Mining Supervisor shall inform the Lessee by written notice of the reasons why the plan is unacceptable and shall give him an opportunity to amend the plan. If an acceptable plan is not submitted to the Mining Supervisor by the Lessee within one year after the Lessee's receipt of the notice, the Mining Supervisor shall send a second written notice to the Lessee concerning the Lessee's failure to submit an acceptable plan. A failure by the Lessee to submit an acceptable plan within 60 days after his receipt of the second written notice without reasonable justification for delay shall be grounds for termination of the Lease, if the Lessor so elects.

(c) After the date of approval of the mining plan, the Lessee shall conduct all activities upon the Leased Lands in accordance with that plan, except for necessary activities for the disposition of property after termination of the Lease pursuant to section 27.

(d) Not less than 30 days after consulting with the Lessee, the Mining Supervisor may reasonably change or supplement the mining plan at any time to be consistent with amended Environmental Stipulations or to adjust to changed conditions or to correct an oversight. If the Lessee seeks to obtain approval of a changed or supplemental plan, he shall submit a written statement of the proposed change or supplement and the justification for the proposed change or supplement. Within 30 days after receiving the written statement from the Lessee, the Mining Supervisor shall, in writing, approve or disapprove the proposed change or supplement, unless he shall advise the Lessee of compelling and valid reasons for requiring more than 30 days to make a decision. In no event shall proposed changes or supplements be effective unless the Mining Supervisor approves of them in writing. Approval of the mining plan will be conditional and temporary to allow mining on an interim basis pending the completion of the Northwest Colorado Coal Environmental Impact Statement. Additional stipulations may be imposed or the mining plan otherwise modified after the completion of the Environmental Impact Statement.

(e) Within 30 days after the end of each calendar year (or if operations cease before the end of the calendar year, within 30 days after cessation of operation), the Lessee shall file with the Mining Supervisor a progress report describing the operations conducted under the mining plan.

Sec. 12. Operations on Leased Lands. (a) In accordance with the Environmental Stipulations incorporated in this Lease, the Lessee shall exercise reasonable diligence, skill, and care in all operations on the Leased Lands. The Lessee's obligations shall include, but not be limited to the following:

(1) The Lessee shall conduct all operations on the Leased Lands so as to avoid injury to life, health, or property;

(2) The Lessee shall avoid or, where avoidance is impracticable, minimize and, where practicable, correct hazards to the public health and safety resulting from his operations on the Leased Lands; and

(3) The Lessee shall minimize to the maximum extent possible

wasting of the mineral deposits and other resources, including but not limited to surface resources which may be found in, upon, or under such lands.

(b) In accordance with the Environmental Stipulations incorporated in this Lease, the Lessee shall take such reasonable steps, and shall conduct operations in such a manner as may be needed to avoid or, where avoidance is impracticable, to minimize and, where practicable, to repair damage to: (1) any forage and timber growth on Federal or non-Federal lands in the vicinity of the Leased Lands; (2) crops, including forage and timber, or improvements of a surface owner; or (3) improvements, whether owned by the United States or by its permittees, licensees, or lessees. The Lessor must approve the steps to be taken and the restoration to be made in the event of the occurrence of damage described in this subsection.

(c) The Lessee shall conduct all operations on the Leased Lands in accordance with the provisions of 30 CFR Part 211 and 43 CFR Part 23, whether they are surface or underground mining operations and whether they are in lands in which the Lessor owns the surface or those in which the Lessor has disposed of the surface.

(d) All water rights developed by Lessee through operations on the Leased Lands or other Federal lands in connection with the development of the Leased Lands shall immediately become the property of the Lessor. As long as the Lease continues, the Lessee shall have the right to use those water rights free of charge for activities under the Lease.

~~Sec. 13. Authorization of Other Uses and Disposition of Leased Lands.~~

~~(a) The Lessor reserves the right to authorize other uses of the Leased Lands by issuing, in addition to the Lease, leases, licenses, permits, easements or rights-of-way, including leases for the development of minerals other than Coal under the Act. The Lessor may authorize any other use that does not unreasonably interfere with the exploration and mining operations of the Lessee.~~

~~(b) The Lessor reserves the right (1) to sell or otherwise dispose of the surface of the Leased Lands under existing law or laws hereafter enacted insofar as said surface is not necessary for the use of the Lessee in the extraction and removal of the Coal therein, or (2) to dispose of any resource in such lands if such disposal will not unreasonably interfere with the exploration and mining operations of the Lessee.~~

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~~(c) If the Leased Lands have been or shall hereafter be disposed of under laws reserving to the United States the deposits of Coal therein, the Lessee shall comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such Coal.~~

~~(d) The Lessee shall make all reasonable efforts to avoid interference with other authorized uses of the Leased Lands.~~

~~(e) The District Manager may authorize the Lessee to charge persons engaged in other uses of the Leased Lands authorized by Lessor such fees as may be appropriate to compensate the Lessee for his expenditures, including loss of interest, to the extent that those expenditures benefit the other use.~~

Sec. 14. Equal Opportunity Clause. The Lessee agrees that during the performance of this contract:

(a) The Lessee will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Lessor setting forth the provisions of this Equal Opportunity Clause.

(b) The Lessee will, in all solicitations or advertisements for employees placed by or on behalf of the Lessee, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(c) The Lessee will send to each labor union or representative of workers with which the Lessee has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Lessor, advising the labor union or workers' representative of the Lessee's commitments under this Equal Opportunity Clause, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) The Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(e) The Lessee will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, as amended, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Secretary of the Interior and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

(f) In the event of the Lessee's noncompliance with the Equal Opportunity Clause of this Lease or with any of said rules, regulations or orders, this Lease may be cancelled, terminated or suspended in whole or in part and the Lessee may be declared ineligible for further Federal Government contracts or leases in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, as amended, and such other sanctions as may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(g) The Lessee will include the provisions of subsections (a) through (g) of this section in every contract, subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order No. 11246 of September 24, 1965, as amended, so that such provisions will be binding upon each contractor, subcontractor, or subcontract, or purchase order as the Secretary of Labor may direct as a means of enforcing such provisions including sanctions for noncompliance; however, in the event the Lessee becomes involved in, or is threatened with, litigation with a contractor, subcontractor or vendor as a result of such direction by the Secretary of Labor, the Lessee may request the Lessor to enter into such litigation to protect the interests of the Lessor.

Sec. 15. Certification of Nonsegregated Facilities By entering into this Lease, the Lessee certifies that he does not and will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not and will not permit his employees to perform their services at any location under his control where segregated facilities are maintained. The Lessee agrees that a breach of this certification is a violation of the Equal Opportunity Clause of this Lease. As used in this certification, the term "segregated facilities" means, but is not limited to, any waiting rooms, work areas, rest rooms or wash rooms, restaurants or other eating areas, time clocks, locker rooms and other storage or dressing rooms, parking lots, drinking fountains, recreation or entertainment areas, transportation facilities and housing facilities provided for employees which are segregated by explicit directive, or are in fact segregated on the basis of race, color, religion, or natural origin because of habit, local custom, or otherwise. The Lessee further agrees that (except where he has obtained identical certifications from proposed contractors and subcontractors for specific time periods) he will obtain identical certifications from proposed contractors and subcontractors prior to the award of contracts or subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause; that he will retain such certifications in his files; that he will forward the following certification to such proposed contractors and subcontractors (except where the proposed contractor or subcontractor has submitted identical certifications for specific time periods); and that he will notify prospective contractors and subcontractors of the requirement for certification of nonsegregated facilities. A Certification of Nonsegregated Facilities, as required by the May 9, 1967 Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a contract or subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each contract and subcontract or for all contracts and subcontracts during a period (i.e. quarterly, semiannually, or annually).

Sec. 16. Employment Practices. The Lessee shall pay all wages due persons employed on the Leased Lands at least twice each month in lawful money of the United States. The Lessee shall grant all miners and other employees complete freedom to purchase goods and service of their own choice. The Lessee shall restrict the workday to not more than 8 hours in any one day for underground workers, except in cases of emergency. The Lessee shall employ no person under the age of 16 years in any mine below the surface. If the laws of the State in which the mine is situated prohibit the employment, in a mine below the surface, of persons of an age greater than 16 years, the Lessee shall comply with those laws.

Sec. 17. Assignment. This Lease may be assigned in whole or in part in accordance with the provisions of 43 CFR Subpart 3506. No assignment may be made where: (a) the proposed assignee is not qualified to hold a Lease under Section 1 of the Act (30 U.S.C. § 181); (b) the proposed assignee is unable to provide an adequate bond; (c) in the case of a proposed partial assignment, either the assigned or the retained portion of the Lease would, in the opinion of the Lessor, be too small to be economically developed; or (d) in the case of a proposed partial assignment, the Lessor does not approve the division of the schedules on which the advance royalties would be based.

Sec. 18. Overriding Royalties. The Lessee shall not create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty payable to the United States under this Lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, except that where an interest in the Leased Lands or in an operating agreement is assigned, the assignor may retain any overriding royalty interest in excess of 50 percent if he shows to the satisfaction of the Bureau that he has made substantial investments for improvements on the Leased Lands covered by the assignment.

Sec. 19. Heirs and Successors-in-interest. Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties thereto.

Sec. 20. Unlawful Interest. No member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(3), shall be admitted to any share or part in this Lease or derive any benefit that may arise therefrom; and the provisions of section 3741 of the Revised Statutes, as amended, 41 U.S.C. §22, and the Act of June 25, 1948, 62 Stat. 702 as amended, 19 U.S.C. §§ 431-433, relating to contracts, enter into and form a part of this Lease insofar as they may be applicable.

Sec. 21. Taxes. The Lessee shall pay, when due, all taxes lawfully assessed and levied upon improvements, outputs of mines, or other rights, property, or assets of the Lessee under the laws of the United States and the State in which the Leased Lands are located.

Sec. 22. Monopoly and Fair Practices. The Lessor reserves full authority to promulgate and enforce orders and regulations under the provisions of sections 30 and 32 of the Act (30 U.S.C. §§ 187,189) necessary to insure that any sale of the production from the Leased Lands to the United States or to the public is at reasonable prices, to prevent monopoly, and to safeguard the public welfare, and such regulations shall upon promulgation be binding upon the Lessee.

Sec. 23. Relinquishment of Lease. Upon a satisfactory showing to the Lessor that he has complied with the terms and conditions of this Lease, the Lessee may surrender the entire Lease or any legal subdivision thereof. A relinquishment must be filed in duplicate with the District Manager. Upon approval of the relinquishment by the District Manager, the relinquishment shall be effective as of the date it is filed, subject to the continued obligation of the Lessee and his surety to make payment of all accrued rentals and royalties, to deliver the premises in compliance with section 27 of this Lease, and to comply with all other applicable requirements of this Lease.

Sec. 24. Proceedings in Case of Default. (a) If the Lessee shall fail to comply with any of the terms and conditions of this Lease, including the terms and conditions of the exploration and mining plans required by sections 10 and 11 of this Lease, and that default shall continue for a period of 30 days after service of notice thereof by the Lessor, the Lessor may (1) suspend operations until the required action is taken to correct noncompliance, or (2) institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this Lease as provided in section 31 of the Act (30 U.S.C. § 188) and for forfeiture of all or part of any applicable bond. Any forfeiture and cancellation of this Lease shall not relieve the Lessee of his obligation to pay all rentals and royalties which have accrued as of the date of the forfeiture and cancellation, to deliver the premises in compliance with section 27 of this Lease and to comply with all other applicable requirements of this Lease.

(b) If the Lessee fails to take prompt and necessary steps to prevent loss or damage to the mine or other parts of the Leased Lands, or to prevent danger to the employees, or to avoid, or, where avoidance is impracticable, to minimize and, where practicable, repair damage to the environment, or, if immediate action by the Lessor, without waiting for action by the Lessee, is required for any of those purposes, the Lessor may enter on the premises and take such measures as he may deem necessary to prevent such loss, damage, or danger, or to correct the damaging, dangerous, or unsafe condition of the mine or any other facilities upon the Leased Lands, and those measures shall be at the expense of the Lessee.

Sec. 25. Waiver of Conditions. The Lessor reserves the right to waive any breach of the conditions contained in this Lease, except the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the Lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this Lease for any other cause, or for the same cause occurring at another time.

Sec. 26. Readjustment of Terms and Conditions. The Lessor may propose the reasonable readjustment of any terms and conditions of this Lease, the first readjustment to be effective at the twentieth Anniversary Date of this Lease and subsequent readjustments to be effective at twenty Lease Year intervals thereafter. At least 120 days before the appropriate Anniversary Date, the Lessor shall give notice to the Lessee of any proposed readjustment of the terms and conditions of the Lease and the nature thereof, and, unless the Lessee, within 60 days after receipt of such notice, files with the Lessor an objection to the proposed terms or relinquishes the Lease as of the appropriate Anniversary Date, the Lessee shall be deemed conclusively to have agreed to such terms and conditions. If the Lessee files objections with the Lessor and agreement cannot be reached between the Lessor and the Lessee within a period of 60 days after the filing of the objection, the Lease may be terminated by either party upon giving 60 days' notice to the other party; however, the Lessor's right to terminate the Lease shall be suspended by the Lessee's filing of a notice of appeal pursuant to section 32 of this Lease, and if the Lessee is ultimately successful in his appeal, the Lease shall continue without the change in the provisions, the imposition of which the Lessee appealed. If the Lessee is unsuccessful in his appeal and, within 60 days of the decision on appeal notifies the Lessor that he accepts the decision rendered upon such appeal, then the Lease shall continue as amended by the decision. If the Lessee files objections to the proposed readjusted terms and conditions, the existing terms and conditions, except those concerning royalties, shall remain in effect until there has been an agreement between the Lessor and the Lessee on the new terms and conditions to be incorporated in the Lease, or until the Lessee has exhausted his rights of appeal under section 32 of this Lease, or until the Lease is terminated; however, the readjusted royalty provisions shall be effective until there is either agreement between the Lessor and the Lessee or until the Lease is terminated. If the readjusted royalty provisions are subsequently rescinded or amended, the Lessee shall be permitted to credit any excess royalty payments against royalties subsequently due to the Lessor.

Sec. 27. Delivery of Premises. (a) In case of the termination of this Lease for any reason, the Lessee shall deliver the premises to the Lessor in accordance with the reclamation requirements of the exploration and mining plans required under sections 10 and 11 of this Lease, and subject to the provisions in this section.

(b) All permanent improvements and other property on the Leased Lands, whether affixed to the ground or movable, including all underground shafts and timbering, well casing or other underground development works, or any other property which the Lessor shall inform the Lessee is necessary for the preservation of the Leased Lands, shall become and remain thereafter a part of the realty without the payment of any compensation to the Lessee. All other structures, equipment, machinery, tools, appliances, and materials on the Leased Lands, whether affixed to the ground or movable, shall remain the property of the Lessee upon the termination of the Lease, but the Lessee shall have no right, for a period of six months following the termination, to remove from the Leased Lands any of that property which in the opinion of the Lessor is useful for the protection of the Leased Lands (including any mines in those lands) unless the Lessor shall expressly authorize the removal. During the six-month period the Lessor shall have the right to purchase at the appraised value any or all items on that property. The appraised value shall be fixed by three disinterested and competent persons (one to be designated by the Lessor, one by the Lessee, and the third by the two so designated), and the appraised value determined by the three, or a majority of them or, if at least two cannot agree on an appraisal, an average of the three appraisals shall be conclusive.

(c) Any structures, machinery, equipment, tools, appliances, and materials, subject to removal by the Lessee as provided above, which are allowed to remain on the Leased Lands shall become the property of the Lessee one year after the termination of this Lease or any extension of that one-year period which may be granted by the Lessor because of adverse climatic conditions or other good and sufficient reason, unless the Lessor shall direct the Lessee to remove any or all of such property before the expiration of the one-year period. If the Lessor directs the Lessee to remove such property, the Lessee shall do so at his own expense or, if he fails to do so within a reasonable period, the Lessor may do so at the Lessee's expense.

Sec. 28. Production and Disposition Records. The Lessee shall maintain books in which will be kept a correct account by weight of all Coal mined; Coal sold, to whom sold and the price received; Coal stored and Coal used on the Leased Lands; and Coal otherwise disposed of.

Sec. 29. Inspections and Investigations. (a) All books and records maintained by the Lessee showing information required by this Lease or regulations must be kept current and in such manner that the books and records can be readily checked, upon request, by the Mining Supervisor or his representative at the place where they are customarily maintained or kept.

(b) The Lessee shall permit any duly authorized officer or representative of the Lessor at any reasonable time (1) to inspect or investigate the Leased Lands and all surface and underground improvements, works, machinery, and equipment, and all books and records pertaining to the Lessee's obligations to the Lessor under this Lease and regulations and (2) to copy and make extracts from any such books and records.

Sec. 30. Proprietary Information. Geological and geophysical interpretations, maps, and data and commercial and financial information required to be submitted under this Lease shall not be available for public inspection without the consent of the Lessee so long as the Lessee furnishing such data, or his successors or assignees, continues to hold this Lease and the land in connection with which the data has been submitted is subject to this Lease.

Sec. 31. Lessee's Liability to Lessor. (a) The Lessee shall be liable to the United States for any damage suffered by the United States in any way arising from or connected with the Lessee's activities and operations under this Lease, except where damage is caused by employees of the United States acting within the scope of their authority.

(b) The Lessee shall indemnify and hold harmless the United States from any and all claims arising from or connected with the Lessee's activities and operations under this Lease.

(c) In any case where liability without fault is imposed on the Lessee pursuant to this section, and the damages involved were caused by the action of a third party, the rules of subrogation shall apply in accordance with the law of the jurisdiction where the damages occurred.

Sec. 32. Appeals. The Lessee shall have the right of appeal (a) under 43 CFR 3000.4 from any action or decision of any official of the Bureau, (b) under 30 CFR Part 290 from any action, order, or decision of any official of the Geological Survey, or (c) under applicable regulation from any action or decision of any other official of the Department of the Interior arising in connection with this Lease, including any action or decision pursuant to section 26 of this Lease with respect to the readjustments of terms and conditions.

THE UNITED STATES OF AMERICA

By Dale J. Andrus
(Signing Officer)

State Director
(Title)

JUN 11 1975
(Date)

WITNESS TO SIGNATURE OF LESSEE

R. W. Sullivan

MORGAN COAL COMPANY

By Har Eiteljorg
(Signature of Lessee)
Harrison Eiteljorg, Managing Partner

(Signature of Lessee)

(Signature of Lessee)

(If this Lease is executed by a corporation, it must bear the corporate seal)

COAL LEASE ENVIRONMENTAL STIPULATIONS

SECTION 1. GENERAL.

(A) Applicability of Stipulations.

The terms, conditions, requirements and prohibitions imposed upon the Lessee by these Stipulations are also imposed upon the Lessee's agents, employees, contractors, and sub-contractors, and their employees. The failure or refusal of the Lessee's agents, employees, contractors, or sub-contractors, or their employees, to comply with these Stipulations shall be deemed to be the failure or refusal of the Lessee. The Lessee shall require his agents, contractors, and sub-contractors to include these Stipulations in all contracts and sub-contracts which are entered into by any of them, together with a provision that the other contracting party, and his agents, employees, contractors, and sub-contractors, and the employees of each of them, shall likewise be bound to comply with these Stipulations.

(B) Changes in Conditions.

These Stipulations are based on existing knowledge and technology. They may be revised or amended, in writing, by the mutual consent of the Mining Supervisor, the District Manager, and the Lessee at any time to adjust to changed conditions or to correct an oversight. Such revisions or amendments may result from, but not be limited to, the Environmental Impact Statement currently being prepared in northwest Colorado on Coal. The Lessor may amend these Stipulations at any time without the consent of the Lessee in order to make these Stipulations consistent with any new Federal of State statutes and with regulations issued under those statutes. The Lessee, the Mining Supervisor, and the District Manager shall meet at least once a year to review advances in technology and, in a mutual endeavor, weigh and decide the feasibility and need of revising or amending existing Stipulations.

The Lessor and the Lessee agree that, in this mutual endeavor to decide upon the feasibility and need for amending the existing Stipulations, they will act in good faith and in a sincere effort to make the Lessee's activities under the lease as free from environmental damage as is practicable. Systems which require pollution control devices shall, whenever possible, possess sufficient flexibility to adopt improved technology when the improvements are available, and the systems shall be constructed with the understanding that continued compliance with changing pollution control laws is required.

(C) Emergency Decisions.

Any decisions or approvals of the Mining Supervisor or District Manager required by these Stipulations to be in writing may in emergencies be issued orally, with written confirmation as soon thereafter as possible.

(D) Construction Standards.

The general design of all buildings and structures shall comply with the latest edition of the Uniform Building Code (U.B.C.). Steel structures shall be designed in accordance with the latest edition of the American Institute of Steel Construction, "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings." Reinforced concrete shall comply with the latest edition of the American Concrete Institute's "Building Code Requirements for Reinforced Concrete." Engineering works for impoundments shall conform to standard engineering practice sufficient to prevent environmental damage which could result from a 100-year flood in the drainage in which installed.

SECTION 2. ACCESS AND SERVICE PLANS.

(A) Pipelines.

In the design, construction and operation of pipelines and the choice of materials for them, the Lessee shall follow the standards (wherever they may be made applicable) established by the Department of Transportation and, if these standards should ever be revised, supplemented, or superseded, shall follow the new standards. These standards include:

(1) 49 CFR 192, Transportation of Natural and Other Gas by Pipeline;

(2) 49 CFR 195, Transmission of Liquids by Pipeline;

(3) 49 CFR, Part 110, Carriers by Pipeline (Other than Natural Gas and Water).

(B) Electric Transmission Facilities.

The Lessee shall design and construct telegraph and telephone lines, electric powerlines, distribution lines and other transmission facilities on the leased lands in accordance with the guidelines set forth in "Environmental Criteria for Electric Transmission Systems," (U.S.D.I., U.S.D.A., 1970), as now or in the future amended, or if these guidelines should be superseded, in the guidelines or other rules superseding them. Distribution lines shall be designed and constructed in accordance with REA Bulletin 61-10, "Powerline Contacts by Eagles and Other Large Birds," as now or in the future amended, or, if these guidelines should be superseded, in the guidelines or other rules superseding them. Nothing in this subsection shall be deemed to require the reconstruction of facilities which at the time of their construction were in compliance with existing rules or guidelines.

(C) Existing and Future Roads and Other Rights-of-Way.

Where feasible, the Lessee shall use existing railroads, roads, trails, and other rights-of-way. Unless the Lessor shall direct otherwise, future railroads, roads, trails and other rights-of-way shall be located, constructed, maintained, and closed according to the specifications of the Bureau and shall include drainage structures where needed.

The Lessee has the responsibility for securing access rights-of-way.

(D) Regulation of Public Access.

After construction on rights-of-way is completed, the Lessee shall, upon consultation with the Lessor, permit reasonable, free and unrestricted public access to and upon roads and other rights-of-way for all lawful and proper purposes except to mine sites, disposal areas, operational haul roads, and other operational areas which may be closed to the general public. The Lessee shall regulate public access and public vehicular traffic as required to facilitate operations and to protect the public and, to the extent reasonable, livestock and wildlife from hazards associated with mining operations. For this purpose, the Lessee shall provide warnings, flagmen, barricades, and other public safety measures as necessary. Whenever the Mining Supervisor shall determine that the Lessee's regulation of access and traffic is unreasonable, or that the Lessee's provision of public safety measures is inadequate, he shall so inform the Lessee who shall immediately take corrective measures.

(E) Waterbars and Breaks.

The Lessee shall divert runoff from roads and uphill slopes by means of waterbars, waterbreaks, or culverts constructed in accordance with Bureau specifications.

(F) Barriers.

Where a railroad, road, trail, pipeline, transmission facility or exploratory site cuts a natural barrier used for livestock control, the Lessee shall, at his own expense, close the opening by the use of a fence or other suitable barrier. All fences, cattleguards and other barriers constructed by the Lessee shall meet established Bureau specifications and standards.

(G) Crossings.

The Lessee shall take all steps necessary to make certain that railroads, roads, trails, pipelines, and transmission facilities constructed under this Lease do not prevent or unreasonably disrupt the use of existing roads, trails, pipelines, and other rights-of-way or major animal migration routes. This requirement shall include the construction of suitable overhead or underground crossings where they are determined to be necessary by the Mining Supervisor or the District Manager.

(H) Alternate Routes.

If any of the Lessee's activities on the leased lands shall interfere with the free use of existing roads and trails used by persons, whether or not recorded, he shall provide such alternate roads and trails as the Mining Supervisor or the District Manager may determine to be needed.

(I) Off-Road Vehicle Use.

The Lessee shall use off-road vehicles in a manner consistent with applicable Federal, State and local regulations.

SECTION 3. FIRE PREVENTION AND CONTROL.

(A) Instructions of the Mining Supervisor.

(1) The Lessee shall comply with regulations (including, but not limited to, 30 CFR, Parts 75, 77, 211, and 43 CFR, Part 23) and with the instructions and directions of the Mining Supervisor concerning the use, prevention, and suppression of fires, and shall make every reasonable effort to prevent, control and suppress any fire on Leased Lands. Uncontrolled fires must be immediately reported to the Mining Supervisor and District Manager.

(2)(a) The Lessee shall construct fire lines or perform clearing when necessary to fight fires or, when determined by the Mining Supervisor or the District Manager to be necessary, to prevent such fires.

(b) The Lessee shall comply with the National Fire Codes on handling, transportation, storage, use and disposal of flammable liquids, gases and solids.

(c) The Lessee shall take all appropriate actions to prevent coal outcrop fires.

(B) Liability of Lessee.

The control and suppression of any fires on the Leased Lands (or on adjoining public lands which have spread from the Leased Lands) caused by the Lessee or his employees, contractors, subcontractors, or agents shall be at the expense of the Lessee. Upon the failure of the Lessee to control and suppress any such fires in a manner satisfactory to the Mining Supervisor or the District Manager, the Mining Supervisor or District Manager shall take such steps as are necessary to control and suppress the fire, either alone or in conjunction with other Federal, State, and local authorities, and the cost of such control and suppression shall be borne by the Lessee.

SECTION 4. FISH AND WILDLIFE.

(A) Management Plan.

The Lessee shall submit to the Mining Supervisor, as part of the mining plan required under Section 11 of this Lease, a detailed fish and wildlife management plan which shall include the steps which the Lessee shall take to: (1) avoid or, where avoidance is impracticable, minimize damage to fish and wildlife habitat, including water supplies; (2) restore, to the extent possible, such habitat in the event it is unavoidably destroyed or damaged; (3) provide alternate habitats where feasible; and (4) provide controlled access to the public for enjoyment of wildlife resources on the leased lands as may be mutually agreed upon. The plan shall include, but not be limited to, detailed information on activities, time schedules, performance standards, proposed accomplishments, and ways and means of avoiding or minimizing environmental impacts on fish and wildlife.

(B) Mitigation of Damage.

Wherever destruction or significant disturbance of fish and wildlife habitat is inevitable, the Lessee shall submit, for the Mining Supervisor's approval at least 60 days prior to the destruction or damage of the habitat, those measures which the Lessee proposes to take to avoid, or, where avoidance is impracticable, minimize and repair injury or destruction of fish and wildlife and their habitat. As a general rule, the proposed measures should provide for habitat of similar type and equal in quantity and quality to that destroyed or damaged. The Mining Supervisor shall, within 60 days after the submission of the proposed measures to him, either approve or disapprove them. If he shall approve them, the Lessee shall execute the proposed measures for the mitigation of the destruction or damage of the habitat. If the Mining Supervisor shall disapprove the measures, he shall offer the Lessee an opportunity for consultation at which, whenever possible, he shall inform the Lessee of any changes which will make the measures acceptable.

(C) Big Game.

The Lessee shall construct big game drift fences when and where necessary to direct big game movements around or away from operational areas as prescribed by the Mining Supervisor.

(D) Posting of Notices.

The Lessee shall post in reasonable and conspicuous places on or adjacent to the Leased Lands notices informing its employees, agents, contractors, subcontractors, and their employees, of all applicable laws and regulations governing hunting, fishing, and trapping.

SECTION 5. HEALTH AND SAFETY.

(A) General.

The Lessee shall take all measures necessary to protect the health and safety of all persons affected by its activities and operations and shall immediately abate any activity or condition which generally threatens the life or health of persons or which threatens any person with bodily harm.

(B) Housing and Welfare of Employees.

In the exercise of his right under Section 1 of the Lease to construct buildings and other facilities for the welfare of his employees, the Lessee shall at all times make certain that these facilities are situated, constructed, operated, and maintained in an orderly manner, satisfactory to the Mining Supervisor or District Manager. While no general restriction is imposed upon the construction of facilities necessary to the employees' health and well-being, such construction shall be subject to the Mining Supervisor's or District Manager's approval and shall not unreasonably damage the environment of the Leased Lands.

Construction of housing and other facilities on the Leased Lands shall require the written approval of the District Manager and shall be subject to county zoning regulations. At the termination of the lease, the Lessee agrees to remove or otherwise dispose of housing and service buildings or any other such facilities to the satisfaction of the Mining Supervisor or District Manager.

(C) Compliance with Federal Health and Safety Laws and Regulations.

The Lessee shall comply with the Federal Coal Mine Health and Safety Act of 1969, 83 Stat. 742, as amended, 30 U.S.C., §§ 801-960, as now in effect or as hereafter amended, or, if it should be superseded, with the statute superseding it; or, if applicable, the Occupational Safety and Health Act of 1970, 84 Stat. 1590, 29 U.S.C., §§ 651-678, as now in effect, or as hereafter amended, or, if it should be superseded, with the statute superseding it; and all health and safety standards and regulations promulgated pursuant to such statutes.

(D) Use of Explosives.

The Lessee shall insure that explosives are used only in accordance with existing State and Federal laws and the requirements specified by the Mining Supervisor. The Lessee shall provide adequate advance written notice by publication or posting of planned blasting schedules to local governments and to residents who might be affected by the use of such explosives, and he shall maintain for a period of at least two years a log of the magnitudes and times of blasts. The Lessee shall limit the type of explosives and detonating equipment, the size, the timing and frequency of blasts based upon the physical conditions of the site so as to prevent injury to persons, damage to public and private property outside the mining site, adverse impacts on any underground mine, and change in the course, channel, or availability of ground or surface water outside the mining site.

SECTION 6. HAZARDOUS MATERIALS.

(A) Responsibility.

If, during operations, any hazardous substance should be discharged, the control, removal, disposal, and cleanup of that substance, wherever found, shall be the responsibility of the Lessee. Upon the failure of the Lessee to control, remove, dispose of, or clean up the discharge, or to repair all damages resulting therefrom, the Mining Supervisor may take such measures as he deems necessary to control, remove, dispose of, or clean up the discharge and restore the area, including, where appropriate, the aquatic environment and fish and wildlife habitats, at the full expense of the Lessee. Such action by the Mining Supervisor shall not relieve Lessee of any responsibility as provided in this Lease.

(B) Reporting of Spills and Discharges.

The Lessee shall give immediate notice of any spills or discharges of hazardous substances to: (1) the Mining Supervisor and (2) such other Federal and State officials as are required by law to be given such notice. Any oral notice shall be confirmed by the Lessee in writing as soon as possible.

(C) Storage and Handling.

The Lessee shall store oil, petroleum products, industrial chemicals and similar toxic or volatile materials in durable containers and locate such materials so that any accidental spillage will not drain into water courses, lakes, reservoirs, or ground water. Unless otherwise approved by the Mining Supervisor, the Lessee shall store substantial quantities (more than 500 gallons) of such materials in an area surrounded by impermeable containment structures. The volume of the containment structures shall be at least: (1) one-hundred fifty (150) percent of the total storage volume of storage tanks in the relevant area; plus (2) a volume sufficient for maximum trapped precipitation and run-off which might be impounded at the time of a spill.

(D) Pesticides and Herbicides.

The Lessee shall not use pesticides and herbicides without the approval of the District Manager (except that within the area of Leased Lands in which actual mining operations are being conducted, this authority shall be supervised by the Mining Supervisor). Pesticides and herbicides shall be considered treatments of last resort to be used only when reasonable alternatives are not available and where their use is consistent with protection and enhancement of the environment. Where pesticides and herbicides are used, they shall be used only with the approval of the Mining Supervisor and the type, amount, method of application, storage, and disposal shall be in accordance with applicable Federal and State procedures.

SECTION 7. POLLUTION--AIR

(A) Air Quality.

The Lessee shall utilize and operate all facilities and devices in such a way as to avoid, or, where avoidance is impracticable, minimize air pollution. At all times during construction and operation, the Lessee shall conduct activities in accordance with all applicable air quality standards and related plans of implementation adopted pursuant to the Clean Air Act, 77 Stat. 392 as amended, 42 U.S.C. §§ 1857, as now in effect or as hereafter amended, of if it should be superseded, the statute superseding it, and applicable State standards.

(B) Dust.

The Lessee shall make every reasonable effort to avoid, or where avoidance is impracticable, minimize dust problems. The Mining Supervisor may require sprinkling, oiling, or other means of dust control on roads, trails, etc. The Lessee shall conduct processing so as to prevent, or if prevention is impossible, minimize to the maximum extent possible, environmental or health problems associated with dust.

(C) Burning.

Open burning is permitted only after securing a burning permit from the Colorado Air Pollution Control Commission. A copy of such burning permit shall be presented to the District Manager and the Mining Supervisor for their approval prior to conducting any such burning.

SECTION 8. POLLUTION -- WATER.

(A) General.

The Lessee shall utilize and operate all facilities and devices in accordance with State and Federal statutes (including, but not limited to, the Federal Water Pollution Control Act, 62 Stat. 1155, as amended, 33 U.S.C., §§ 1251-1376) and regulations as now in effect or as hereafter amended, or if they should be superseded, the statute and regulations superseding them, and he shall minimize the disturbance to the prevailing hydrologic balance at the mine site and in associated off-site areas and to the quality and quantity of water in surface and ground water systems, during both coal mining and reclamation operations, by:

(1) Avoiding acid or other toxic mine drainage by such measures as, but not limited to, preventing or removing water from contact with toxic-producing deposits; treating drainage to reduce toxic content which adversely affects downstream water upon being released to water courses; containing harmful ground water encountered in the mining operation; or casing, sealing, or otherwise managing bore holes, shafts, and wells to keep acid or other toxic drainage from entering ground and surface waters;

(2) Conducting surface mining operations so as to prevent to the maximum extent practicable additional contributions of suspended solids to stream flow or runoff outside the mining site above natural levels under seasonal flow conditions as measured prior to any mining, and avoiding channel deepening or enlargement in operations requiring the discharge of water from mines;

(3) Removing temporary or large siltation structures from drainways after disturbed areas are revegetated and stabilized;

(4) Restoring, to the maximum extent possible, recharge capacity of the aquifer at the mine site to approximate premining conditions;

(5) Preserving to the maximum extent practicable, through the mining and reclamation process, the hydrologic integrity of alluvial valley floors in arid and semiarid areas;

(6) Implementing such other measures as the Mining Supervisor may prescribe.

(B) Disturbance of Existing Waters.

(1) All activities, exclusive of actual mining activities, that may cause the creation of new lakes, drainage of existing ponds, diversion of natural drainages, alteration of stream hydraulics, disturbance of areas of stream beds or degradation of land and water quality or adversely affect the environmental integrity of the area are prohibited unless approved in writing by the Mining Supervisor and with the owners' prior written consent.

(2) The location of crossings of perennial streams, lakes and rivers must be approved in writing by the Mining Supervisor.

(3) In conducting all activities, including actual mining activities, the Lessee shall, to control erosion, maintain buffer strips at least 200 feet wide on each side of a stream in their natural and undisturbed state unless otherwise authorized in writing by the Mining Supervisor.

(4) In addition to complying with the provisions of subsection (3), the Lessee shall not cut or fill near or in streams or drainages if it would result in siltation or accumulation of debris unless approved in writing by the Mining Supervisor.

(C) Road Surfacing Material.

All road surfacing material used by the Lessee must be approved by the Mining Supervisor or the District Manager.

SECTION 9. POLLUTION -- NOISE.

The Lessee shall comply with all applicable Federal, State or local standards on noise pollution, as now in effect or as hereafter amended, or, if they should be superseded, the standards superseding them. In the absence of specific noise pollution standards, the Lessee shall keep noise at or below levels safe and acceptable for humans, as determined by the Mining Supervisor or the District Manager.

SECTION 10. REHABILITATION.

The Leased Lands shall be rehabilitated in a manner that will avoid or minimize environmental impacts off the Leased Lands and be in accordance with Federal, State and local surface rehabilitation statutes and regulations.

SECTION 11. CLEARING AND STRIPPING

The Lessee may clear and strip only such lands as are necessary for mining, processing, and other operations under the Lease. In connection with such operations, the Lessee may clear and strip land necessary for roadbeds, but the widths of such roadbeds shall be not more than 25 feet from the centerline, unless otherwise specified by the Mining Supervisor or District Manager.

SECTION 12. WASTE DISPOSAL.

Disposal of mine and other wastes shall be carried out pursuant to applicable Federal, State and local laws and regulations.

SECTION 13. SCENIC VALUES.

(A) Scenic Considerations in General.

The Lessee shall, except where the Mining Supervisor or District Manager has approved otherwise, use the following standards in all designing, clearing, earthmoving, and construction:

(1) Contours compatible with the natural environment shall be used to avoid straight lines wherever feasible.

(2) Natural colors consistent with the local environment such as pastels or muted shades of brown, green, red, or grey shall be used in the painting of facilities installed on the Leased Lands. Bright or unnatural colors shall be avoided except for use in warning signs or other markings for safety purposes.

(3) Small natural openings or the edges of larger openings in the natural environment shall be utilized in the construction of facilities or disturbing the land surface whenever feasible.

(4) During the time when the land is disturbed, the portion of land which is not under revegetation programs shall only be those areas required under the mining plan for mining, storage, or processing operations.

(B) Consideration of Aesthetic Values.

The Lessee shall consider existing aesthetic values in all planning, construction, reclamation and mining operations. All roads, trails, railroads, pipelines and transmission lines shall, where practicable, be constructed so as to minimize visual impact, to make use of the natural topography, and, wherever feasible, to achieve harmony with the landscape.

(C) Protection of Landscape.

The Lessee shall design any structures and facilities built under this Lease so that they will, to the extent practicable, blend with the natural landscape.

(D) Signs.

The Lessee shall design and construct signs that are rustic in appearance, except for warning signs and other marking for safety purposes, and they shall conform to the sign standards of the Bureau.

SECTION 14. ANTIQUITIES AND OBJECTS OF HISTORIC AND SCIENTIFIC VALUE.

(A) "Cultural resources," for the purpose of this section, shall be defined as any district, site, building, structure, or object of American historical, scientific prehistoric, archaeological, or architectural significance. Prior to the submission of any exploration or mining plan, the Lessee shall engage a qualified independent expert who shall conduct a survey, acceptable to the District Manager, of the lands to be disturbed under that plan and immediately adjoining lands to determine the existence of cultural resources. (Information collected prior to the Effective Date as to cultural resources on the Leased Lands shall, with the approval of the District Manager, satisfy all or part of the survey requirements of this section.) The expert conducting the survey shall be a person acceptable to the District Manager and the terms and conditions of the contract under which the survey is conducted shall be subject to approval of the District Manager. The contract shall provide that the expert shall be directly responsible to the Lessor, and the Lessor shall, upon approval of the contract, become a party thereto. The District Manager shall approve (or disapprove, as the case may be) the contract not later than 30 days after the Lessee submits the contract to him. The survey, at the discretion of the Lessee, may be in two parts, one covering the lands which are the subject of the exploration plan and one covering the lands which are the subject of the mining plan, or may be in one part including the lands which are the subject of both the exploration plan and the mining plan. The responsibility and cost of the survey and of any salvage that may be required as a result of such survey will be that of the Lessee. No plan in connection with which a survey is prepared shall be approved before the expert has completed a survey acceptable to the District Manager. In order that the requirements of this section may be expeditiously fulfilled, the Lessee may elect to have the expert on hand during exploration or mining to complete the necessary survey of additional lands not covered by the initial survey before those lands are disturbed pursuant to changes which the Mining Supervisor approves in the exploration or mining plan. In the event that the survey identifies cultural resources, the plan shall contain provisions to avoid the disturbance of such discoveries until the Lessee and the Lessor have complied with the law with respect to such discoveries.

(B) The Lessee shall immediately bring to the attention of the Mining Supervisor any cultural resources discovered as a result of operations under this Lease and shall leave such discoveries intact. The Mining Supervisor shall immediately inform the District Manager of the discovery and the District Manager shall, within ten days thereafter, evaluate the discoveries brought to his attention to determine whether such discoveries may be potentially qualified for inclusion in the National Register of Historic Place or may be otherwise significant as a cultural resource. If the District Manager shall make such determination in the affirmative, he shall immediately refer this determination to the appropriate officer of the Department of the Interior for review and approval of potential qualification, which shall be made within ten days thereafter. During this period for determination and evaluation of the discovery, the Lessee shall comply with the directions of the District Manager so as to avoid the disturbance of the cultural resource.

THE UNITED STATES OF AMERICA

By ____________________
(Signing Officer)

WITNESS TO SIGNATURE OF LESSEE

State Director
(Title)

____

JUN 11 1975
(Date)

____

R. W. Sullivan

MORGAN COAL COMPANY

By ____________________
(Signature of Lessee)
Harrison Eiteljorg, Managing Partner

____
(Signature of Lessee)

____
(Signature of Lessee)

(If this Lease is executed by a corporation, it must bear the corporate seal)

4—696
(August 1942)

UNITED STATES
DEPARTMENT OF THE INTERIOR

District Land Office Denver

Serial No. 052547

MINING LEASE OF COAL LANDS UNDER ACT OF FEBRUARY 25, 1920

This indenture of lease, entered into, in quintuplicate, this 1st day of March A. D. 1945, by and between the United States of America, acting in this behalf by the Assistant Secretary of the Interior, party of the first part, hereinafter called the lessor, and Thomas P.Greenhelgh, of Hiawatha, Utah, party of the second part, hereinafter called the lessee, under, pursuant, and subject to the terms and provisions of the act of Congress, approved February 25, 1920 (41 Stat. 437), entitled "An act to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain," hereinafter called the "act."

Witnesseth:

That the lessor, in consideration of the rents and royalties to be paid and the covenants to be observed as hereinafter set forth, does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in, upon, or under the following described tracts of land, situated in the State of Colorado, to wit: Lots 2, 3, SE¼ sec. 9, T. 4 N., S½SE¼ sec. 29, NE¼, NE¼SE¼ sec. 32, W½ sec. 33, T. 5 N., all in R. 86 W., 6th P.M., containing 853.27 acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Section 1. That the lessor expressly reserves:

(1*a*) The right to permit for joint or several use such easements or rights of way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in said act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(1*b*) The right to lease, sell, or otherwise dispose of the surface of said lands or any part thereof under existing law or laws hereafter enacted, in so far as said surface is not necessary for the use of the lessee in the mining and removal of the coal therein, and to lease other mineral deposits in the lands, under the provisions of said act.

(1*c*) Full power and authority to carry out and enforce all the provisions of Section 30 of said act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly; and to safeguard the public welfare.

Section 2. The lessee in consideration of the lease of the rights and privileges aforesaid hereby covenants and agrees as follows:

(2*a*) To invest in actual mining operations, development, or improvements upon the land leased, or for the benefit thereof, the sum of fifty thousand dollars, of which sum not less than one-third shall be so expended during the first year succeeding the execution of this instrument and a like sum each of the two succeeding years, unless sooner expended; and submit annually, at the expiration of each year for the said period, an itemized statement of the amount and character of said expenditure during such year.

(2*b*) To furnish a bond in the sum of $10,000 conditioned upon the expenditure of the amount specified in (2*a*) hereof and upon compliance with all the other terms of the lease. (In case of a $10,000 bond, a bond in the sum of $5,000 may be substituted after the investment requirement has been met.)

(2*c*) To pay as an annual rental for each acre or part thereof covered by this lease, the sum of 25 cents per acre for the first year, payment of which amount is hereby acknowledged, the sum of 50 cents per acre per year for the second, third, fourth, and fifth years, and $1 per acre for the sixth and each succeeding year during the life of

10—30653-1

this lease, all such annual payments of rental to be made to the register of the District Land Office of the district in which said land is situated, on the anniversary of the date hereof, and to be credited on the first royalties to become due hereunder during the year for which said rental was paid.

(2d) To pay to such register a royalty of 15 cents on every ton of 2,000 pounds of coal mined during the first two years succeeding the execution of this lease, and a royalty of not less than 10 cents a ton at any time thereafter when in the opinion of the Secretary of the Interior a reduction in the rate is warranted. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

the weight or weights thereof in due form in books to be kept and preserved by the lessee for such purpose.

(2*f*) To furnish quarterly, within 30 days after the expiration of the quarter, a written report covering such quarter, certified under oath by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the number of tons of 2,000 pounds of coal mined during the quarter, the character and quality thereof, amount of coal and products and by-products thereof disposed of and price received therefor, amount of coal and its products in storage or held for sale, and amount used in operations under this lease.

(2*g*) Also to furnish annually, and at such other times as the Secretary of the Interior may require, in the manner and form prescribed by the Secretary of the Interior, plat, map, or tracings showing all development work and improvements upon the leased lands, and other related information, with a report as to all buildings, structures, or other works placed in or upon the leased lands, a statement as to the amount and grade of coal produced and sold, and amount received therefor by operations hereunder, and, if a corporation, the amount of capital stock and list of its stockholders.

(2*h*) To keep at the mine office clear, accurate, and detailed maps, on a scale not more than 200 feet to the inch, in the form of horizontal projections on tracing cloth, of the workings in each coal bed in each separate mine on the leased lands, a separate map to be made for each such bed, and for the surface immediately over the underground workings, and to be so arranged with reference to a public land corner that the maps can be readily superimposed.

Each map of the workings in any coal bed shall show the thickness of the coal and of partings, and the dip and strike of each bed at intervals of 500 feet or less; the location of all openings connecting such bed with the workings in any other bed, or with any adjacent mine, or with the surface; the location of all entries, gangways, rooms, or breasts, and all other mine openings, shafts, airways, appliances, and devices, constructed or placed in the mine or any of the workings thereof; and such maps shall also show the elevation relative to sea level or a Government survey corner of the principal points of the various beds and workings.

Blue prints or reproductions in duplicate of the maps required as aforesaid shall be furnished the lessor when made, and supplemental prints or reproductions in duplicate furnished on or before the first day of each succeeding year, showing the extensions, additions, and changes since the last map or supplement was submitted. All mine progress maps kept by the lessee shall at all times be subject to examination by lessor.

(2*i*) That, beginning with the fourth year of the lease, except when such operation shall be interrupted by strikes, the elements, or casualties not attributable to the lessee, the lessee shall mine and pay a royalty on not less than 25,000 tons of coal per year, unless on application and showing made, operations shall be suspended for not exceeding six months at any one time, pursuant to section 7 of the act; or unless the lessee shall pay the royalty less rent, on such minimum amount of coal, for one year in advance, in which case operations may be suspended for that year.

(2*j*) That the lessee shall not assign this lease or any interest therein, nor sublet any portion of the leased premises without the written consent of the lessor being first had and obtained.

SECTION 3. It is mutually understood and agreed that the lessor shall have the right to readjust and fix the royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof, and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period, but in case the lessee be dissatisfied with the rate of royalty or other terms and conditions so fixed, he may terminate this lease in the manner and under the conditions provided in Sections 6 (*b*) and 6 (*c*) hereof.

J.P.M. **The lessee shall not discriminate against any employee or applicant for employment because of race, creed, color, or national origin, and shall require an identical provision to be included in all subcontracts.**

Section 4. This lease is made subject to the following provisions, which the lessee accepts and covenants faithfully to perform and observe, unless the laws of the State where the leased land or deposits are situated otherwise provide, in which case such State laws control:

(4*a*) The lessee shall carry out and observe regulations prescribed by the Secretary of the Interior and in force at the date hereof relative to (1) reasonable diligence, skill, and care in the operation of said property in accordance with approved methods and practices: (2) the prevention of undue waste: (3) the safety and welfare of miners; and (4) insuring the fair and just weighing or measurement of the coal mined by each miner.

(4*b*) And also shall pay all miners and other employees, both above and below ground, at least twice each month in lawful money of the United States, and shall permit such miners and other employees full and complete freedom of purchase, but with a view to increasing safety this provision shall not apply to the purchase of explosives, detonators, or fuses; and shall not require or permit miners or other employees, except in case of emergency, to work underground for more than eight hours in any one workday, and shall not employ any boy under the age of 16 years, or any girl or woman without regard to age in any mine below the surface.

Section 5. And the lessee also expressly agrees that all mining and related operations shall be subject to the inspection of authorized representatives of the lessor, and that such representatives, with all proper and necessary assistants, may at all reasonable times enter into and upon the leased lands and survey and examine same and all surface and underground improvements, works, machinery, equipment, and operations.

(5*a*) And also shall permit the lessor to examine all books and records pertaining to operations under this lease, and to make copies of and extracts from any or all of same, if desired.

(5*b*) And also shall permit the lessor or its lessees or transferees, with the approval of the lessor, to make and use upon or under the leased lands any workings necessary for freeing any other mine from water or gas, or extinguishing fires, causing as little damage or interference as possible to or with the mine or mining operations of the lessee hereunder; *provided*, that any such use by a transferee or another lessee shall be conditioned upon the payment to the lessee hereunder of the amount of actual damages sustained thereby and adequate compensation for such use.

(5*c*) And also shall, at the termination of this lease, as the result of forfeiture thereof, pursuant to paragraph (6*d*), deliver up to the lessor the lands covered thereby, including all fixtures, machinery, improvements, and appurtenances, other than strictly personal property, situate on any of said lands, in good order and condition, so as to permit of immediate continued operation to the full extent and capacity of the leased premises.

Section 6. It is further mutually understood and agreed as follows:

(6*a*) That the lessor may, in writing, waive any breach of the covenants and conditions contained herein, except such as are required by the act, but any such waiver shall extend only to the particular breach so waived, and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

(6*b*) The lessee may, on consent of the Secretary of the Interior first had and obtained, surrender and terminate this lease upon payment of all rents, royalties, and other debts due and payable to the lessor and upon payment of all wages or moneys due and payable to the workmen employed by the lessee, and upon a satisfactory showing to the Secretary of the Interior that the public interest will not be impaired; and the lessee may with like consent surrender any legal subdivision of the area included within the lease; but in no case shall such termination be effective until the lessee shall have made provision for the preservation of any mines or productive works or permanent improvements on the lands covered hereby.

(6*c*) That on the termination of this lease, pursuant to the last preceding paragraph, the lessor, his agent, licensee, or lessee shall have the exclusive right at the lessor's election to purchase at any time within six months thereafter, at the appraised value, any or all buildings, machinery, tools, or other property placed by the lessee in or on the lands leased hereunder, save and except all underground timber and such other supports and structures as are necessary for the protection and preservation of the mine, which shall be and remain a part of the realty without further consideration or compensation; that the purchase price to be paid for said buildings, machinery, equipment, tools, or other property to be purchased as aforesaid shall be fixed by appraisal of three disinterested and competent persons (one to be designated by each party hereto and the third to be selected by the two so designated), the valuation so determined by the three or a majority of them to be conclusive and binding upon both parties; that pending such election to purchase within the said period of six months none of the buildings or other property shall be removed from their normal position; that if such valuation be not requested or the lessor shall affirmatively, in writing, elect not to purchase within said period of six months, the lessee shall have the privilege of removing said buildings, machinery, equipment, tools, and other property within 90 days after being notified in writing by the lessor that the said lessor does not elect to purchase any or all of the buildings, machinery, equipment, tools, or other property, and in case of failure to so remove the said property within 90 days after receipt of such notice, then said buildings, machinery, tools, or other property shall become the property of the United States.

(*6d*) If the lessee shall fail to comply with the provisions of the act or make default in the performance or observance of any of the terms, covenants, and stipulations hereof, or of the general regulations promulgated and in force at date hereof, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the act, but this provision shall not be construed as depriving the lessor of any legal or equitable remedy which the lessor might otherwise have.

Section 7. It is further covenanted and agreed that, should the lessee fail to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of lessee.

Section 8. It is further covenanted and agreed that each obligation hereunder shall extend to and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Section 9. It is also further agreed that no member of or delegate to Congress, or resident commissioner, after his election or appointment, or either before or after he has qualified, and during his continuance in office, and that no officer, agent, or employee of the Department of the Interior, shall be admitted to any share or part in this lease, or derive any benefit that may arise therefrom, and the provisions of Section 3741 of the Revised Statutes of the United States and Sections 114, 115, and 116 of the Codification of the Penal Laws of the United States, approved March 4, 1909 (35 Stat. 1109), relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

In witness whereof:

THE UNITED STATES OF AMERICA,

MAR - 1 1945 By Oscar L Chapman
Assistant Secretary of the Interior, Lessor.

Thomas P. Greenhalgh
Lessee.

Witnesses:

Charles W. Schoelzel Jr
376 Dexter Denver Colo
Denver, Colo
Frances Reilly

U. S. GOVERNMENT PRINTING OFFICE 16—30553-1

COAL LEASE D-034365
OF
W. R. GRACE AND COMPANY

(Original lease issued to Clifford G. Phelan, thence assigned to Colowyo Coal Company, and finally to W. R. Grace and Company.)

4—696
(August 1912)

UNITED STATES
DEPARTMENT OF THE INTERIOR

MODIFIED

District Land Office **Denver**

Serial No. **034365**

MINING LEASE OF COAL LANDS UNDER ACT OF FEBRUARY 25, 1920

This indenture of lease, entered into. in quintuplicate, this **25th** day of **October** A. D. 19**24**, by and between the United States of America, acting in this behalf by the Assistant Secretary of the Interior, party of the first part, hereinafter called the lessor, and **Clifford G. Phelan**, of **Axial, Colorado**, party of the second part, hereinafter called the lessee. under. pursuant, and subject to the terms and provisions of the act of Congress, approved February 25, 1920 (41 Stat. 437), entitled "An act to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain." hereinafter called the "act."

Witnesseth:

That the lessor, in consideration of the rents and royalties to be paid and the covenants to be observed as hereinafter set forth, does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in, upon, or under the following described tracts of land, situated in the State of **Colorado**, to wit: **Lots 3, 4, 10, 13, 22, 23, SW¼NE¼, SE½ sec. 2, T. 3 N., R. 93 W., 6th P. M.,** containing **310.69** acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Section 1. That the lessor expressly reserves:

(1*a*) The right to permit for joint or several use such easements or rights of way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in said act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(1*b*) The right to lease, sell, or otherwise dispose of the surface of said lands or any part thereof under existing law or laws hereafter enacted, in so far as said surface is not necessary for the use of the lessee in the mining and removal of the coal therein, and to lease other mineral deposits in the lands, under the provisions of said act.

(1*c*) Full power and authority to carry out and enforce all the provisions of Section 30 of said act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly; and to safeguard the public welfare.

Section 2. The lessee in consideration of the lease of the rights and privileges aforesaid hereby covenants and agrees as follows:

(2*a*) To invest in actual mining operations, development, or improvements upon the land leased, or for the benefit thereof, the sum of **five hundred** dollars, **which is determined to have been expended.** [illegible]

(2*b*) To furnish a bond in the sum of $**1,000.00** conditioned upon the expenditure of the amount specified in (2*a*) hereof and upon compliance with all the other terms of the lease. (In case of a $10,000 bond, a bond in the sum of $5,000 may be substituted after the investment requirement has been met.)

(2*c*) To pay as an annual rental for each acre or part thereof covered by this lease, the sum of 25 cents per acre for the first year, payment of which amount is hereby acknowledged, the sum of 50 cents per acre per year for the second, third, fourth, and fifth years, and $1 per acre for the sixth and each succeeding year during the life of

16—30852-1

this lease, all such annual payments of rental to be made to the register of the District Land Office of the district in which said land is situated, on the anniversary of the date hereof, and to be credited on the first royalties to become due hereunder during the year for which said rental was paid.

(2*d*) To pay to such register a royalty of ..15............ cents 10 cents on the new land on every ton of 2,000 pounds of coal mined during the first 20 years succeeding the execution of this lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

(2*e*) To determine accurately the weight of all coal mined from the leased premises, and to accurately enter the weight or weights thereof in due form in books to be kept and preserved by the lessee for such purpose.

(2*f*) To furnish quarterly, within 30 days after the expiration of the quarter, a written report covering such quarter, certified under oath by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the number of tons of 2,000 pounds of coal mined during the quarter, the character and quality thereof, amount of coal and products and by-products thereof disposed of and price received therefor, amount of coal and its products in storage or held for sale, and amount used in operations under this lease.

(2*g*) Also to furnish annually, and at such other times as the Secretary of the Interior may require, in the manner and form prescribed by the Secretary of the Interior, plat, map, or tracings showing all development work and improvements upon the leased lands, and other related information, with a report as to all buildings, structures, or other works placed in or upon the leased lands, a statement as to the amount and grade of coal produced and sold, and amount received therefor by operations hereunder, and, if a corporation, the amount of capital stock and list of its stockholders.

(2*h*) To keep at the mine office clear, accurate, and detailed maps, on a scale not more than 200 feet to the inch, in the form of horizontal projections on tracing cloth, of the workings in each coal bed in each separate mine on the leased lands, a separate map to be made for each such bed, and for the surface immediately over the underground workings, and to be so arranged with reference to a public land corner that the maps can be readily superimposed.

Each map of the workings in any coal bed shall show the thickness of the coal and of partings, and the dip and strike of each bed at intervals of 500 feet or less; the location of all openings connecting such bed with the workings in any other bed, or with any adjacent mine, or with the surface; the location of all entries, gangways, rooms, or breasts, and all other mine openings, shafts, airways, appliances, and devices, constructed or placed in the mine or any of the workings thereof; and such maps shall also show the elevation relative to sea level or a Government survey corner of the principal points of the various beds and workings.

Blue prints or reproductions in duplicate of the maps required as aforesaid shall be furnished the lessor when made, and supplemental prints or reproductions in duplicate furnished on or before the first day of each succeeding year, showing the extensions, additions, and changes since the last map or supplement was submitted. All mine progress maps kept by the lessee shall at all times be subject to examination by lessor.

(2*i*) That, beginning with the fourth year of the lease, except when such operation shall be interrupted by strikes, the elements, or casualties not attributable to the lessee, the lessee shall mine and pay a royalty on not less than ......5,000...... tons of coal per year, unless on application and showing made, operations shall be suspended for not exceeding six months at any one time, pursuant to section 7 of the act; or unless the lessee shall pay the royalty less rent, on such minimum amount of coal, for one year in advance, in which case operations may be suspended for that year.

(2*j*) That the lessee shall not assign this lease or any interest therein, nor sublet any portion of the leased premises without the written consent of the lessor being first had and obtained.

SECTION 3. It is mutually understood and agreed that the lessor shall have the right to readjust and fix the royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof, and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period, but in case the lessee be dissatisfied with the rate of royalty or other terms and conditions so fixed, he may terminate this lease in the manner and under the conditions provided in Sections 6 (*b*) and 6 (*c*) hereof.

16—30652-1

The lessee shall not discriminate against any employee or applicant for employment because of race, creed, color, or national origin, and shall require an identical provision to be included in all subcontracts.

SECTION 4. This lease is made subject to the following provisions, which the lessee accepts and covenants faithfully to perform and observe, unless the laws of the State where the leased land or deposits are situated otherwise provide, in which case such State laws control:

(4*a*) The lessee shall carry out and observe regulations prescribed by the Secretary of the Interior and in force at the date hereof relative to (1) reasonable diligence, skill, and care in the operation of said property in accordance with approved methods and practices; (2) the prevention of undue waste; (3) the safety and welfare of miners; and (4) insuring the fair and just weighing or measurement of the coal mined by each miner.

(4*b*) And also shall pay all miners and other employees, both above and below ground, at least twice each month in lawful money of the United States, and shall permit such miners and other employees full and complete freedom of purchase, but with a view to increasing safety this provision shall not apply to the purchase of explosives, detonators, or fuses; and shall not require or permit miners or other employees, except in case of emergency, to work underground for more than eight hours in any one workday, and shall not employ any boy under the age of 16 years, or any girl or woman without regard to age in any mine below the surface.

SECTION 5. And the lessee also expressly agrees that all mining and related operations shall be subject to the inspection of authorized representatives of the lessor, and that such representatives, with all proper and necessary assistants, may at all reasonable times enter into and upon the leased lands and survey and examine same and all surface and underground improvements, works, machinery, equipment, and operations.

(5*a*) And also shall permit the lessor to examine all books and records pertaining to operations under this lease, and to make copies of and extracts from any or all of same, if desired.

(5*b*) And also shall permit the lessor or its lessees or transferees, with the approval of the lessor, to make and use upon or under the leased lands any workings necessary for freeing any other mine from water or gas, or extinguishing fires, causing as little damage or interference as possible to or with the mine or mining operations of the lessee hereunder: *provided*, that any such use by a transferee or another lessee shall be conditioned upon the payment to the lessee hereunder of the amount of actual damages sustained thereby and adequate compensation for such use.

(5*c*) And also shall, at the termination of this lease, as the result of forfeiture thereof, pursuant to paragraph (6*d*), deliver up to the lessor the lands covered thereby, including all fixtures, machinery, improvements, and appurtenances, other than strictly personal property, situate on any of said lands, in good order and condition, so as to permit of immediate continued operation to the full extent and capacity of the leased premises.

SECTION 6. It is further mutually understood and agreed as follows:

(6*a*) That the lessor may, in writing, waive any breach of the covenants and conditions contained herein, except such as are required by the act, but any such waiver shall extend only to the particular breach so waived, and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

(6*b*) The lessee may, on consent of the Secretary of the Interior first had and obtained, surrender and terminate this lease upon payment of all rents, royalties, and other debts due and payable to the lessor and upon payment of all wages or moneys due and payable to the workmen employed by the lessee, and upon a satisfactory showing to the Secretary of the Interior that the public interest will not be impaired; and the lessee may with like consent surrender any legal subdivision of the area included within the lease; but in no case shall such termination be effective until the lessee shall have made provision for the preservation of any mines or productive works or permanent improvements on the lands covered hereby.

(6*c*) That on the termination of this lease, pursuant to the last preceding paragraph, the lessor, his agent, licensee, or lessee shall have the exclusive right at the lessor's election to purchase at any time within six months thereafter, at the appraised value, any or all buildings, machinery, tools, or other property placed by the lessee in or on the lands leased hereunder, save and except all underground timber and such other supports and structures as are necessary for the protection and preservation of the mine, which shall be and remain a part of the realty without further consideration or compensation: that the purchase price to be paid for said buildings, machinery, equipment, tools, or other property to be purchased as aforesaid shall be fixed by appraisal of three disinterested and competent persons (one to be designated by each party hereto and the third to be selected by the two so designated), the valuation so determined by the three or a majority of them to be conclusive and binding upon both parties; that pending such election to purchase within the said period of six months none of the buildings or other property shall be removed from their normal position: that if such valuation be not requested or the lessor shall affirmatively, in writing, elect not to purchase within said period of six months, the lessee shall have the privilege of removing said buildings, machinery, equipment, tools, and other property within 90 days after being notified in writing by the lessor that the said lessor does not elect to purchase any or all of the buildings, machinery, equipment, tools, or other property, and in case of failure to so remove the said property within 90 days after receipt of such notice, then said buildings, machinery, tools, or other property shall become the property of the United States.

(*6d*) If the lessee shall fail to comply with the provisions of the act or make default in the performance or observance of any of the terms, covenants, and stipulations hereof, or of the general regulations promulgated and in force at date hereof, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the act, but this provision shall not be construed as depriving the lessor of any legal or equitable remedy which the lessor might otherwise have.

SECTION 7. It is further covenanted and agreed that, should the lessee fail to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of lessee.

SECTION 8. It is further covenanted and agreed that each obligation hereunder shall extend to and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

SECTION 9. It is also further agreed that no member of or delegate to Congress, or resident commissioner, after his election or appointment, or either before or after he has qualified, and during his continuance in office, and that no officer, agent, or employee of the Department of the Interior, shall be admitted to any share or part in this lease, or derive any benefit that may arise therefrom, and the provisions of Section 3741 of the Revised Statutes of the United States and Sections 114, 115, and 116 of the Codification of the Penal Laws of the United States, approved March 4, 1909 (35 Stat. 1109), relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA,

JAN 24 1945 By Oscar L. Chapman
Assistant Secretary of the Interior, Lessor.

x Clifford G. Phelan
Lessee.

WITNESSES:

N. O. Marchant 704 Boston Bldg Denver, Colo
W. B. Cook Craig, Colo

SERIAL REGISTER PAGE

Legal Reference	File Code	Serial Number
Right-of-Way	2800	C-23377

Name and Mailing Address

Colowyo Coal Co., Div. of W. R. Grace & Co., Denver, CO
7935 E. Prentice, Bldg. 40

Description of Land

T. 4 N., R. 93 W., 6th P.M.
Sec 22: Lot 10
Sec 23: Lot 10
Sec 26: Lots 4, 8, 9
Sec 27: SE¼, S½NE¼
Sec 34: NE¼
Sec 35: Lots 3, 6, 8, 17, 18, NW¼, NW¼SW¼
T. 3 N., R. 93 W., 6th P.M.
Sec 2: Lots 3, 10, 13, 22, 23, NE¼SW¼
Sec 11: Northern 630, 94 feet of Lot 5

Moffat County

DATE OF ACTION	ACTION TAKEN
Dec 4, 1975	Received right-of-way application for the construction and use of a tramroad related to a coal mining operation across the above described lands.

Legal Description of National Resource Lands Applied for on Colowyo Mine Access Road Right-of-Way.

COAL LEASES C-081251
C-081258
C-0114093
OF
PEABODY COAL COMPANY

(United Electric Coal Companies has appointed Peabody the Designated Operator of Coal Leases C-081251 and C-081258. Sentry Royalty Company assigned Coal Lease C-0114093 to Peabody on February 5, 1968.)

Form 4–696
(January 1964)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PREFERENCE-RIGHT COAL LEASE

Land Office
Colorado

Serial Number
C-081251

FILE
JM

MAY 1 1965

This lease, entered into on the day of , 19 , by the United States of America, the lessor,

through the Bureau of Land Management, and **The United Electric Coal Companies**
307 North Michigan Avenue
Chicago 1, Illinois
, the lessee,

RECEIVED
COLORADO LAND OFFICE
DENVER, COLORADO
1965 APR 21 PM 2 03

pursuant and subject to the terms and provisions of the Act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the Act, and to all reasonable regulations of the Secretary of the Interior now or hereafter in force which are made a part hereof,

WITNESSETH:

Sec. 1. *Rights of Lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of **Colorado.**

T. 5 N., R. 88 W., 6th P.M.
Sec. 3: Lot 5, SW¼NE¼, W½SE¼
Sec. 9: NW¼SE¼, S½SE¼
Sec. 10: All
Sec. 14: W½W½
Sec. 15: All
Sec. 20: E½E½
Sec. 21: N½
Sec. 22: N½

containing **2,519.03** acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Sec. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) Bond. To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount or furnish such other bond as may be required.

(b) Rental. To pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year; 50 cents for the second, third, fourth, and fifth years, respectively; and $1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

(c) Royalty. To pay the lessor a royalty of cents on every ton of 2,000 pounds of coal mined during the first 20 years succeeding the execution of this lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined. **(See Attached Royalty Schedule)**

(d) Minimum production. Beginning with the sixth year of the lease, *except* when operations are interrupted by strikes, the elements, or casualties not attributable to the lessee, or unless on application and showing made, operations shall be suspended when market conditions are such that the lessee cannot operate *except* at a loss or suspended for the other reasons specified in Section 39 of the Act, to mine coal each year and pay a royalty thereon to a value of $1 per acre or fraction thereof. Operations under this lease shall be continuous *except* in circumstances described or unless the lessee shall pay a royalty, less rent, on such minimum amount of the leased deposits, for one year in advance, in which case operations may be suspended for that year.

(e) Payments. To make rental payments to the Manager of the appropriate Land Office, *except* that when this lease becomes productive the rentals and

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royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) Plats, reports, maps. At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the appropriate regulations.

(g) Weights. To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter accurately the weight or quantity and quality thereof in due form in books to be kept and preserved by the lessee for such purposes.

(h) Inspection. To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

(i) Assignment. To file for approval in the appropriate Land Office within 90 days from the date of execution, any assignment or transfer made of this lease, whether by direct assignment, operating agreement, working or royalty interest, or otherwise. Such instrument will take effect the first day of the month following its approval by the Bureau of Land Management, or if the assignee requests, the first day of the month of approval. The showing required to be made with an assignment or transfer is set forth in the appropriate regulations.

(j) Nondiscrimination clauses. During the performance of this contract the lessee agrees as follows:

(1) The lessee will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the lessee's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The lessee will comply with all provisions of Executive Order No. 10925 of March 6, 1961, as amended, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The lessee will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, as amended, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the lessee's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this lease may be cancelled, terminated, or suspended in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, as amended, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The lessee will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order No. 10925 of March 6, 1961, as amended, so that such provisions will be binding upon each subcontractor or vendor. The lessee will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the lessee becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

(k) Land disposed of with coal deposits reserved to the United States. If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) Operations, wages, freedom of purchase. To comply with the appropriate operating regulations, to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground

ROYALTY SCHEDULE

For the first 10 years, a royalty rate of 15 cents a ton for coal mined by underground methods, and 17½ cents a ton for coal mined by strip or surface-auger mining methods, and for the remainder of the 20-year period a royalty rate of 17½ cents a ton for coal mined by underground methods, and 20 cents a ton for coal mined by strip or surface-auger mining methods.

Form 1510–11
(June 1964)
(formerly 4–1634)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NONDISCRIMINATION IN EMPLOYMENT

During the performance of this contract the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited, to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the contractor's commitments under this Section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The contractor will comply with all provisions of Executive Order Number 10925 of March 6, 1961, as amended, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The contractor will furnish all information an reports required by Executive Order Number 10925 March 6, 1961, as amended, and by the rules, reg lations, and orders of the said Committee, or pursuar thereto, and will permit access to his books, records and accounts by the contracting agency and the Con mittee for purposes of investigation to ascertai compliance with such rules, regulations, and orders

(6) In the event of the contractor's noncomplianc with the nondiscrimination clauses of this contract c with any of the said rules, regulations, or orders, thi contract may be cancelled, terminated, or suspended i whole or in part and the contractor may be declared in eligible for further Government contracts in accordanc with procedures authorized in Executive Order Numbe 10925 of March 6, 1961, as amended, and such othe sanctions may be imposed and remedies invoked as pro vided in the said Executive Order or by rule, regulation or order of the President's Committee on Equal Em ployment Opportunity, or as otherwise provided by law

(7) The contractor will include the provisions o paragraphs (1) through (7) in every subcontract o purchase order unless exempted by rules, regulations or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 o Executive Order Number 10925 of March 6, 1961, as amended, so that such provisions will be binding upor each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions fo noncompliance: *Provided, however,* that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the contractor may request the United States to enter intc such litigation to protect the interests of the United States.

workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman, without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) Taxes. To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) Overriding royalties. Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) Delivery of premises in case of forfeiture. In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) Rights reserved. The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) Disposition of surface. The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) Monopoly and fair prices. Full power and authority to promulgate and enforce all the provisions of Section 30 of the Act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) Readjustment of terms. The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) Waiver of conditions. The right to waive any breach of the conditions contained herein, *except* the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. *Relinquishment of lease.* Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment *must* be filed in *duplicate* in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improvements on the leased lands in accordance with the regulations and terms of the lease.

Sec. 5. *Protection of the surface, natural resources, and improvements.* The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. *Removal of equipment, etc., on termination of lease.* Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, *except* underground timbering placed by the lessee in or on the leased lands, which are necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. *Proceedings in case of default.* If the lessee shall not comply with any of the provisions of the Act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the Act. If the lessee fails to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall

not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. *Heirs and successors in interest.* Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. *Unlawful interest.* No Member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom; and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 U.S.C. Sec. 22), and Sections 431, 432, and 433, Title 18, U.S.C., relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

NONDISCRIMINATION IN EMPLOYMENT

THIS CONTRACT (LEASE, LICENSE, PERMIT) IS SUBJECT TO THE PROVISIONS OF SEC. 301 OF EXECUTIVE ORDER NO. 10925, A COPY OF WHICH IS ATTACHED.

THE UNITED STATES OF AMERICA

By Lola M. Clark
(Signing Officer)

ASSISTANT MANAGER,
BRANCH OF MINERALS ADJUDICATION
(Title)

APR 22 1965
(Date)

WITNESS TO SIGNATURE OF LESSEE

THE UNITED ELECTRIC COAL COMPANIES
(Signature of Lessee)

Secretary

x J M Moore
(Signature of Lessee)
President

(Signature of Lessee)

(If this lease is executed by a corporation, it must bear the corporate seal)

Form 4–696
(January 1964)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

RECEIVED
LAND OFFICE
COLORADO
1965 APR 21 PM 2 59

Land Office
Colorado

Serial Number
C-081258

PREFERENCE RIGHT COAL LEASE

This lease, entered into on the MAY 1 1965 day of 19 by the United States of America, the lessor, through the Bureau of Land Management, and

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

The United Electric Coal Companies
307 North Michigan Avenue
Chicago, Illinois 60601

, the lessee, pursuant and subject to the terms and provisions of the Act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the Act, and to all reasonable regulations of the Secretary of the Interior now or hereafter in force which are made a part hereof,

WITNESSETH:

Sec. 1. *Rights of Lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of **Colorado**

T. 5 N., R. 88 W., 6th P.M.
Sec. 23: All
Sec. 26: All
Sec. 27: NE¼, N½S½
Sec. 33: NE¼
Sec. 34: NW¼
Sec. 35: NE¼, Lots 3,4,5,6,11 and 12

containing **2,323.44** acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Sec. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) Bond. To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount or furnish such other bond as may be required.

(b) Rental. To pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year; 50 cents for the second, third, fourth, and fifth years, respectively; and $1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

(c) Royalty. To pay the lessor a royalty of cents on every ton of 2,000 pounds of coal mined during the first 20 years succeeding the execution of this lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

(See attached Royalty Schedule)

(d) Minimum production. Beginning with the sixth year of the lease, *except* when operations are interrupted by strikes, the elements, or casualties not attributable to the lessee, or unless on application and showing made, operations shall be suspended when market conditions are such that the lessee cannot operate *except* at a loss or suspended for the other reasons specified in Section 39 of the Act, to mine coal each year and pay a royalty thereon to a value of $1 per acre or fraction thereof. Operations under this lease shall be continuous *except* in circumstances described or unless the lessee shall pay a royalty, less rent, on such minimum amount of the leased deposits, for one year in advance, in which case operations may be suspended for that year.

(e) Payments. To make rental payments to the Manager of the appropriate Land Office, *except* that when this lease becomes productive the rentals and

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royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) Plats, reports, maps. At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the appropriate regulations.

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(h) Inspection. To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

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(j) Nondiscrimination clauses. During the performance of this contract the lessee agrees as follows:

(1) The lessee will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the lessee's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The lessee will comply with all provisions of Executive Order No. 10925 of March 6, 1961, as amended, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The lessee will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, as amended, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the lessee's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this lease may be cancelled, terminated, or suspended in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, as amended, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

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ROYALTY SCHEDULE

For the first 10 years, a royalty rate of 15 cents a ton for coal mined by underground methods, and 17½ cents a ton for coal mined by strip or surface-auger mining methods, and for the remainder of the 20-year period a royalty rate of 17½ cents a ton for coal mined by underground methods, and 20 cents a ton for coal mined by strip or surface-auger mining methods.

Form 1510–11
(June 1964)
(formerly 4–1634)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NONDISCRIMINATION IN EMPLOYMENT

During the performance of this contract the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited, to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

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workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman, without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) Taxes. To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) Overriding royalties. Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) Delivery of premises in case of forfeiture. In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) Rights reserved. The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) Disposition of surface. The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) Monopoly and fair prices. Full power and authority to promulgate and enforce all the provisions of Section 30 of the Act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) Readjustment of terms. The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) Waiver of conditions. The right to waive any breach of the conditions contained herein, *except* the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. *Relinquishment of lease.* Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment *must* be filed in *duplicate* in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improvements on the leased lands in accordance with the regulations and terms of the lease.

Sec. 5. *Protection of the surface, natural resources, and improvements.* The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. *Removal of equipment, etc., on termination of lease.* Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, *except* underground timbering placed by the lessee in or on the leased lands, which are necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. *Proceedings in case of default.* If the lessee shall not comply with any of the provisions of the Act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the Act. If the lessee fails to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall

not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. *Heirs and successors in interest.* Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. *Unlawful interest.* No Member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom; and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 U.S.C. Sec. 22), and Sections 431, 432, and 433, Title 18, U.S.C., relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

NONDISCRIMINATION IN EMPLOYMENT

THIS CONTRACT (LEASE, LICENSE, PERMIT) IS SUBJECT TO THE PROVISIONS OF SEC. 301 OF EXECUTIVE ORDER NO. 10925, A COPY OF WHICH IS ATTACHED.

THE UNITED STATES OF AMERICA

By Lola M. Clark
(Signing Officer)

ASSISTANT MANAGER,
BRANCH OF MINERALS ADJUDICATION
(Title)

APR 22 1965
(Date)

WITNESS TO SIGNATURE OF LESSEE

THE UNITED ELECTRIC COAL COMPANIES
(Signature of Lessee)

Secretary

(Signature of Lessee)
President

(Signature of Lessee)

(If this lease is executed by a corporation, it must bear the corporate seal)

Form 4–696
(January 1964)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

COAL LEASE

Land Office
Colorado

Serial Number
C-0114093

FILE

Clark

This lease, entered into on the day of **MAY 1, 1964**, by the United States of America, the lessor, through the Bureau of Land Management, and

Sentry Royalty Company
301 Olive Street
St. Louis, Missouri 63102

, the lessee, pursuant and subject to the terms and provisions of the Act of February 25, 1920 (41 Stat. 437), as amended, hereinafter referred to as the Act, and to all reasonable regulations of the Secretary of the Interior now or hereafter in force which are made a part hereof,

WITNESSETH:

Sec. 1. *Rights of Lessee.* The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in the following-described tracts of land, situated in the State of Colorado.

T. 5 N., R. 87 W., 6th P.M.
Sec. 17: S½, SW¼NE¼, SE¼NW¼, W½NW¼
Sec. 18: E½E½, SW¼SE¼
Sec. 19: E½NW¼, NE¼, W½SE¼
F
Sec. 20: NW¼, W½SW¼
Sec. 29: NW¼NW¼
Sec. 30: NE¼NE¼

containing 1320 acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

Sec. 2. In consideration of the foregoing, the lessee hereby agrees:

(a) Bond. To maintain the bond furnished upon the issuance of this lease, which bond is conditioned upon compliance with all the provisions of the lease, and to increase the amount or furnish such other bond as may be required.

(b) Rental. To pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date hereof, the following rentals: 25 cents for the first year; 50 cents for the second, third, fourth, and fifth years, respectively; and $1 for the sixth and each succeeding year during the continuance of the lease, such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid.

(c) Royalty. To pay the lessor a royalty of 30 days from the expiration of the quarter in which the coal is mined. *(See attached Royalty rate)

(d) Minimum production. Beginning with the sixth year of the lease, *except* when operations are interrupted by strikes, the elements, or casualties not attributable to the lessee, or unless on application and showing made, operations shall be suspended when market conditions are such that the lessee cannot operate *except* at a loss or suspended for the other reasons specified in Section 39 of the Act, to mine coal each year and pay a royalty thereon to a value of $1 per acre or fraction thereof. Operations under this lease shall be continuous *except* in circumstances described or unless the lessee shall pay a royalty, less rent, on such minimum amount of the leased deposits, for one year in advance, in which case operations may be suspended for that year.

*

(c) Royalty. The royalty is 15 cents a ton of 2,000 pounds mine run for coal mined by underground methods and 17½ cents a ton for coal mined by strip mining or surface auger mining methods.

royalties shall be paid to the appropriate Regional Mining Supervisor of the United States Geological Survey, with whom all reports concerning operations under the lease shall be filed. All remittances to the Manager of the Land Office shall be made payable to the Bureau of Land Management, those to the Geological Survey shall be made payable to the United States Geological Survey.

(f) Plats, reports, maps. At such times and in such form as the lessor may prescribe, to furnish a plat showing development work and improvements on the leased lands and a report with respect to stockholders, investment, depreciation, and costs. To furnish in such form as the lessor may prescribe, within 30 days from the expiration of each quarter a report covering such quarter, certified by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the amount of leased deposits mined during the quarter, the character and quality thereof, amount of its products and byproducts disposed of and price received therefor, and amount in storage or held for sale. To keep and prepare maps of the leased lands in accordance with the appropriate regulations.

(g) Weights. To determine accurately the weight or quantity and quality of all leased deposits mined, and to enter accurately the weight or quantity and quality thereof in due form in books to be kept and preserved by the lessee for such purposes.

(h) Inspection. To permit at all reasonable times (1) inspection by any duly authorized officer of the Department, of the leased premises and all surface and underground improvements, works, machinery, equipment, and all books and records pertaining to operations and surveys or investigations under this lease; and (2) the lessor to make copies of and extracts from any or all books and records pertaining to operations under this lease, if desired.

(i) Assignment. To file for approval in the appropriate Land Office within 90 days from the date of execution, any assignment or transfer made of this lease, whether by direct assignment, operating agreement, working or royalty interest, or otherwise. Such instrument will take effect the first day of the month following its approval by the Bureau of Land Management, or if the assignee requests, the first day of the month of approval. The showing required to be made with an assignment or transfer is set forth in the appropriate regulations.

(j) Nondiscrimination clauses. During the performance of this contract the lessee agrees as follows:

(1) The lessee will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. The lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The lessee will, in all solicitations or advertisements for employees placed by or on behalf of the lessee, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The lessee will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the lessee's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The lessee will comply with all provisions of Executive Order No. 10925 of March 6, 1961, as amended, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The lessee will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, as amended, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the lessee's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this lease may be cancelled, terminated, or suspended in whole or in part and the lessee may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, as amended, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The lessee will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order No. 10925 of March 6, 1961, as amended, so that such provisions will be binding upon each subcontractor or vendor. The lessee will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the lessee becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the lessee may request the United States to enter into such litigation to protect the interests of the United States.

(k) Land disposed of with coal deposits reserved to the United States. If the lands embraced herein have been or shall hereafter be disposed of under laws reserving to the United States the deposits of coal therein, to comply with all conditions as are or may hereafter be provided by the laws and regulations reserving such coal.

(l) Operations, wages, freedom of purchase. To comply with the appropriate operating regulations, to exercise reasonable diligence, skill, and care in the operations of the property, and to carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health or property, and of waste or damage to any water or mineral deposits; to fairly and justly weigh or measure the coal mined by each miner, to pay all wages due miners and employees, both above and below ground, at least twice each month in lawful money of the United States; to accord all miners and employees complete freedom of purchase; to restrict the workday to not exceeding eight hours in any one day for underground

workers, except in cases of emergency; to employ no boy under the age of sixteen and no girl or woman, without regard to age, in any mine below the surface; unless the laws of the State otherwise provide, in which case the State laws control.

(m) Taxes. To pay when due, all taxes lawfully assessed and levied under the laws of the State or the United States upon improvements, output of mines, or other rights, property, or assets of the lessee.

(n) Overriding royalties. Not to create, by assignment or otherwise, an overriding royalty interest in excess of 50 percent of the rate of royalty first payable to the United States under this lease or an overriding royalty interest which when added to any other outstanding overriding royalty interest exceeds that percentage, excepting, that where an interest in the leasehold or in an operating agreement is assigned, the assignor may retain an overriding royalty interest in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management, that he has made substantial investments for improvements on the land covered by the assignment.

(o) Delivery of premises in case of forfeiture. In case of forfeiture of this lease, to deliver up to the lessor in good order and condition the land leased, including all buildings, and underground timbering and such other supports and structures as are necessary for the preservation of the mine or deposit.

Sec. 3. The lessor expressly reserves:

(a) Rights reserved. The right to permit for joint or several use such easements or rights-of-way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in the Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(b) Disposition of surface. The right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the coal therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under this lease.

(c) Monopoly and fair prices. Full power and authority to promulgate and enforce all the provisions of Section 30 of the Act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly, and to safeguard the public welfare.

(d) Readjustment of terms. The right reasonably to readjust and fix royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period. Unless the lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for a 20-year period, he will be deemed to have agreed to such terms.

(e) Waiver of conditions. The right to waive any breach of the conditions contained herein, *except* the breach of such conditions as are required by the Act, but any such waiver shall extend only to the particular breach so waived and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

Sec. 4. *Relinquishment of lease.* Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or any legal subdivision thereof. A relinquishment *must* be filed in *duplicate* in the appropriate Land Office. Upon its acceptance it shall be effective as of the date it is filed, subject to the continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improvements on the leased lands in accordance with the regulations and terms of the lease.

Sec. 5. *Protection of the surface, natural resources, and improvements.* The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of the leased land to its former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the United States and improvements thereon.

Sec. 6. *Removal of equipment, etc., on termination of lease.* Upon termination of this lease, by surrender or forfeiture, the lessee shall have the privilege at any time within a period of 90 days thereafter of removing from the premises all machinery, equipment, tools and materials, *except* underground timbering placed by the lessee in or on the leased lands, which are necessary for the preservation of the mine. Any materials, tools, appliances, machinery, structures, and equipment, subject to removal as above provided, which are allowed to remain on the leased lands shall become the property of the lessor on expiration of the 90-day period or such extension thereof as may be granted because of adverse climatic conditions, but the lessee shall remove any or all of such property where so directed by the lessor.

Sec. 7. *Proceedings in case of default.* If the lessee shall not comply with any of the provisions of the Act or the regulations thereunder or default in the performance or observance of any of the provisions of this lease, and such default shall continue for a period of 30 days after service of written notice thereof by the lessor, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the Act. If the lessee fails to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of the lessee. However, the lessee shall

not be held responsible for delays or casualties occasioned by causes beyond the lessee's control.

Sec. 8. *Heirs and successors in interest.* Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 9. *Unlawful interest.* No Member of, or Delegate to, Congress, or Resident Commissioner, after his election or appointment, or either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Department of the Interior, except as provided in 43 CFR 7.4(a)(1), shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom; and the provisions of Section 3741 of the Revised Statutes of the United States, as amended (41 U.S.C. Sec. 22), and Sections 431, 432, and 433, Title 18, U.S.C., relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

NONDISCRIMINATION IN EMPLOYMENT

THIS CONTRACT (LEASE, LICENSE, PERMIT) IS SUBJECT TO THE PROVISIONS OF SEC. 301 OF EXECUTIVE ORDER NO. 10925, A COPY OF WHICH IS ATTACHED

THE UNITED STATES OF AMERICA

TPS APR 14 '64 -mo

By ______________________
(Signing Officer)

Land Office Manager
(Title)

WITNESS TO SIGNATURE OF LESSEE

April 13, 1964
(Date)

ATTEST:

SENTRY ROYALTY COMPANY

Mulvaney
Assistant Secretary

By: C. E. Stokes, Vice-Pres
(Signature of Lessee)

Irma D. Onken

____
(Signature of Lessee)

____
(Signature of Lessee)

(If this lease is executed by a corporation, it must bear the corporate seal)

orm 4—1634
April 1962)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NONDISCRIMINATION IN EMPLOYMENT

In connection with the performance of work under his contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of ace, creed, color, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

(3) The Contractor will send to each labor union or representative of workers with which he has a collective-bargaining agreement or other contract or understanding, a notice, to be provided by the agency Contracting Officer, advising the said labor union or workers' representative of the Contractor's commitments under this nondiscrimination clause, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Contractor will comply with all provisions of Executive Order No. 10925 of March 6, 1961, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

(5) The Contractor will furnish all information and reports required by Executive Order No. 10925 of March 6, 1961, and by the rules, regulations, and orders of the said Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Contractor's noncompliance with the nondiscrimination clause of this contract or with any of the said rules, regulations, or orders, this contract may be canceled in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

(7) The Contractor will include the provisions of the foregoing paragraphs (1) through (6) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to section 303 of Executive Order No. 10925 of March 6, 1961, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

NOTE TO CONTRACTOR

Additional requirement for subcontracts with the Department of the Interior.

In compliance with the Rules and Regulations (41 CFR, section 60–1.3(a)) issued under Executive Order 10925 of March 6, 1961, the prime contractor is hereby bound and agrees to include in each subcontract which it shall make with a subcontractor or supplier paragraphs (1) through (7) of section 301 of said Executive Order (as quoted above), unless exempted pursuant to the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity.

GPO 855220

GPO 832077

COAL LEASE D-051698
OF
RUBY CONSTRUCTION COMPANY, INC.

(Original lease issued to Thomas E. Barton and subsequently assigned to Ruby Construction Co.)

4—696

UNITED STATES
DEPARTMENT OF THE INTERIOR

U. S. LAND OFFICE AT Denver

SERIAL NO. 051698

MINING LEASE OF COAL LANDS UNDER ACT OF FEBRUARY 25, 1920

This indenture of lease, entered into, in quintuplicate, this 11th day of September, A. D. 1941, by and between the United States of America, acting in this behalf by the First Assistant Secretary of the Interior, party of the first part, hereinafter called the lessor, and Thomas E. Harton, of Mt. Morrison, Colorado, party of the second part, hereinafter called the lessee, under, pursuant, and subject to the terms and provisions of the act of Congress, approved February 25, 1920 (41 Stat. 437), entitled "An act to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain," hereinafter called the " act."

WITNESSETH:

That the lessor, in consideration of the rents and royalties to be paid and the covenants to be observed as hereinafter set forth, does hereby grant and lease to the lessee the exclusive right and privilege to mine and dispose of all the coal in, upon, or under the following described tracts of land, situated in the State of Colorado, to wit: lots 2, 3, 4 Sec. 12, T. 4 N., R. 89 W., 6th P. M., containing 146.26 acres, more or less, together with the right to construct all such works, buildings, plants, structures, and appliances as may be necessary and convenient for the mining and preparation of the coal for market, the manufacture of coke or other products of coal, the housing and welfare of employees, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted.

SECTION 1. That the lessor expressly reserves:

(1*a*) The right to permit for joint or several use such easements or rights of way, including easements in tunnels upon, through, or in the land leased, occupied, or used as may be necessary or appropriate to the working of the same or other lands containing the deposits described in said act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

(1*b*) The right to lease, sell, or otherwise dispose of the surface of said lands or any part thereof under existing law or laws hereafter enacted, in so far as said surface is not necessary for the use of the lessee in the mining and removal of the coal therein, and to lease other mineral deposits in the lands, under the provisions of said act.

(1*c*) Full power and authority to carry out and enforce all the provisions of Section 30 of said act to insure the sale of the production of said leased lands to the United States and to the public at reasonable prices, to prevent monopoly; and to safeguard the public welfare.

SECTION 2. The lessee in consideration of the lease of the rights and privileges aforesaid hereby covenants and agrees as follows:

(2*a*) To invest in actual mining operations, development, or improvements upon the land leased, or for the benefit thereof, the sum of two thousand dollars, of which sum not less than one-third shall be so expended during the first year succeeding the execution of this instrument and a like sum each of the two succeeding years, unless sooner expended: and submit annually, at the expiration of each year for the said period, an itemized statement of the amount and character of said expenditure during such year.

(2*b*) To furnish a bond in the sum of $1,000.00 conditioned upon the expenditure of the amount specified in (2*a*) hereof and upon compliance with all the other terms of the lease. (In case of a $10,000 bond, a bond in the sum of $5,000 may be substituted after the investment requirement has been met.)

(2*c*) To pay as an annual rental for each acre or part thereof covered by this lease, the sum of 25 cents per acre for the first year, payment of which amount is hereby acknowledged, the sum of 50 cents per acre per year for the second, third, fourth, and fifth years, and $1 per acre for the sixth and each succeeding year during the life of

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this lease, all such annual payments of rental to be made to the register of the United States Land Office of the district in which said land is situated, on the anniversary of the date hereof, and to be credited on the first royalties to become due hereunder during the year for which said rental was paid.

(2*d*) To pay to such register a royalty of ......15.......... cents on every ton of 2,000 pounds of coal mined during the first 20 years succeeding the execution of this lease. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

(2*e*) To determine accurately the weight of all coal mined from the leased premises, and to accurately enter the weight or weights thereof in due form in books to be kept and preserved by the lessee for such purpose.

(2*f*) To furnish quarterly, within 30 days after the expiration of the quarter, a written report covering such quarter, certified under oath by the superintendent of the mine, or by such other agent having personal knowledge of the facts as may be designated by the lessee for such purpose, showing the number of tons of 2,000 pounds of coal mined during the quarter, the character and quality thereof, amount of coal and products and by-products thereof disposed of and price received therefor, amount of coal and its products in storage or held for sale, and amount used in operations under this lease.

(2*g*) Also to furnish annually, and at such other times as the Secretary of the Interior may require, in the manner and form prescribed by the Secretary of the Interior, plat, map, or tracings showing all development work and improvements upon the leased lands, and other related information, with a report as to all buildings, structures, or other works placed in or upon the leased lands, a statement as to the amount and grade of coal produced and sold, and amount received therefor by operations hereunder, and, if a corporation, the amount of capital stock and list of its stockholders.

(2*h*) To keep at the mine office clear, accurate, and detailed maps, on a scale not more than 200 feet to the inch, in the form of horizontal projections on tracing cloth, of the workings in each coal bed in each separate mine on the leased lands, a separate map to be made for each such bed, and for the surface immediately over the underground workings, and to be so arranged with reference to a public land corner that the maps can be readily superimposed.

Each map of the workings in any coal bed shall show the thickness of the coal and of partings, and the dip and strike of each bed at intervals of 500 feet or less; the location of all openings connecting such bed with the workings in any other bed, or with any adjacent mine, or with the surface; the location of all entries, gangways, rooms, or breasts, and all other mine openings, shafts, airways, appliances, and devices, constructed or placed in the mine or any of the workings thereof; and such maps shall also show the elevation relative to sea level or a Government survey corner of the principal points of the various beds and workings.

Blue prints or reproductions in duplicate of the maps required as aforesaid shall be furnished the lessor when made, and supplemental prints or reproductions in duplicate furnished on or before the first day of each succeeding year, showing the extensions, additions, and changes since the last map or supplement was submitted. All mine progress maps kept by the lessee shall at all times be subject to examination by lessor.

(2*i*) That, beginning with the fourth year of the lease, except when such operation shall be interrupted by strikes, the elements, or casualties not attributable to the lessee, the lessee shall mine and pay a royalty on not less than ....980.............. tons of coal per year, unless on application and showing made, operations shall be suspended for not exceeding six months at any one time, pursuant to section 7 of the act; or unless the lessee shall pay the royalty less rent, on such minimum amount of coal, for one year in advance, in which case operations may be suspended for that year.

(2*j*) That the lessee shall not assign this lease or any interest therein, nor sublet any portion of the leased premises without the written consent of the lessor being first had and obtained.

SECTION 3. It is mutually understood and agreed that the lessor shall have the right to readjust and fix the royalties payable hereunder and other terms and conditions at the end of 20 years from the date hereof, and thereafter at the end of each succeeding 20-year period during the continuance of this lease unless otherwise provided by law at the time of the expiration of any such period, but in case the lessee be dissatisfied with the rate of royalty or other terms and conditions so fixed, he may terminate this lease in the manner and under the conditions provided in Sections 6 (*b*) and 6 (*c*) hereof.

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SECTION 4. This lease is made subject to the following provisions. which the lessee accepts and covenants faithfully to perform and observe, unless the laws of the State where the leased land or deposits are situated otherwise provide, in which case such State laws control:

(*4a*) The lessee shall carry out and observe regulations prescribed by the Secretary of the Interior and in force at the date hereof relative to (1) reasonable diligence, skill, and care in the operation of said property in accordance with approved methods and practices; (2) the prevention of undue waste; (3) the safety and welfare of miners; and (4) insuring the fair and just weighing or measurement of the coal mined by each miner.

(*4b*) And also shall pay all miners and other employees, both above and below ground, at least twice each month in lawful money of the United States, and shall permit such miners and other employees full and complete freedom of purchase, but with a view to increasing safety this provision shall not apply to the purchase of explosives, detonators, or fuses; and shall not require or permit miners or other employees, except in case of emergency, to work underground for more than eight hours in any one workday, and shall not employ any boy under the age of 16 years, or any girl or woman without regard to age in any mine below the surface.

SECTION 5. And the lessee also expressly agrees that all mining and related operations shall be subject to the inspection of authorized representatives of the lessor, and that such representatives, with all proper and necessary assistants, may at all reasonable times enter into and upon the leased lands and survey and examine same and all surface and underground improvements, works, machinery, equipment, and operations.

(*5a*) And also shall permit the lessor to examine all books and records pertaining to operations under this lease, and to make copies of and extracts from any or all of same, if desired.

(*5b*) And also shall permit the lessor or its lessees or transferees, with the approval of the lessor, to make and use upon or under the leased lands any workings necessary for freeing any other mine from water or gas, or extinguishing fires, causing as little damage or interference as possible to or with the mine or mining operations of the lessee hereunder; *provided*, that any such use by a transferee or another lessee shall be conditioned upon the payment to the lessee hereunder of the amount of actual damages sustained thereby and adequate compensation for such use.

(*5c*) And also shall, at the termination of this lease, as the result of forfeiture thereof, pursuant to paragraph (*6d*), deliver up to the lessor the lands covered thereby, including all fixtures, machinery, improvements, and appurtenances, other than strictly personal property, situate on any of said lands, in good order and condition, so as to permit of immediate continued operation to the full extent and capacity of the leased premises.

SECTION 6. It is further mutually understood and agreed as follows:

(*6a*) That the lessor may, in writing, waive any breach of the covenants and conditions contained herein, except such as are required by the act, but any such waiver shall extend only to the particular breach so waived, and shall not limit the rights of the lessor with respect to any future breach; nor shall the waiver of a particular cause of forfeiture prevent cancellation of this lease for any other cause, or for the same cause occurring at another time.

(*6b*) The lessee may, on consent of the Secretary of the Interior first had and obtained, surrender and terminate this lease upon payment of all rents, royalties, and other debts due and payable to the lessor and upon payment of all wages or moneys due and payable to the workmen employed by the lessee, and upon a satisfactory showing to the Secretary of the Interior that the public interest will not be impaired; and the lessee may with like consent surrender any legal subdivision of the area included within the lease; but in no case shall such termination be effective until the lessee shall have made provision for the preservation of any mines or productive works or permanent improvements on the lands covered hereby.

(*6c*) That on the termination of this lease, pursuant to the last preceding paragraph, the lessor, his agent, licensee, or lessee shall have the exclusive right at the lessor's election to purchase at any time within six months thereafter, at the appraised value, any or all buildings, machinery, tools, or other property placed by the lessee in or on the lands leased hereunder, save and except all underground timber and such other supports and structures as are necessary for the protection and preservation of the mine, which shall be and remain a part of the realty without further consideration or compensation; that the purchase price to be paid for said buildings, machinery, equipment, tools, or other property to be purchased as aforesaid shall be fixed by appraisal of three disinterested and competent persons (one to be designated by each party hereto and the third to be selected by the two so designated), the valuation so determined by the three or a majority of them to be conclusive and binding upon both parties; that pending such election to purchase within the said period of six months none of the buildings or other property shall be removed from their normal position; that if such valuation be not requested or the lessor shall affirmatively, in writing, elect not to purchase within said period of six months, the lessee shall have the privilege of removing said buildings, machinery, equipment, tools, and other property within 90 days after being notified in writing by the lessor that the said lessor does not elect to purchase any or all of the buildings, machinery, equipment, tools, or other property, and in case of failure to so remove the said property within 90 days after receipt of such notice, then said buildings, machinery, tools, or other property shall become the property of the United States.

(6*d*) If the lessee shall fail to comply with the provisions of the act or make default in the performance or observance of any of the terms, covenants, and stipulations hereof, or of the general regulations promulgated and in force at date hereof, the lessor may institute appropriate proceedings in a court of competent jurisdiction for the forfeiture and cancellation of this lease as provided in Section 31 of the act, but this provision shall not be construed as depriving the lessor of any legal or equitable remedy which the lessor might otherwise have.

SECTION 7. It is further covenanted and agreed that, should the lessee fail to take prompt and necessary steps to prevent loss or damage to the mine, property, or premises, or danger to the employees, the lessor may enter on the premises and take such measures as may be deemed necessary to prevent such loss or damage or to correct the dangerous or unsafe condition of the mine or works thereof, which shall be at the expense of lessee.

SECTION 8. It is further covenanted and agreed that each obligation hereunder shall extend to and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

SECTION 9. It is also further agreed that no member of or delegate to Congress, or resident commissioner, after his election or appointment, or either before or after he has qualified, and during his continuance in office, and that no officer, agent, or employee of the Department of the Interior, shall be admitted to any share or part in this lease, or derive any benefit that may arise therefrom, and the provisions of Section 3741 of the Revised Statutes of the United States and Sections 114, 115, and 116 of the Codification of the Penal Laws of the United States, approved March 4, 1909 (35 Stat. 1109), relating to contracts, enter into and form a part of this lease so far as the same may be applicable.

IN WITNESS WHEREOF:

THE UNITED STATES OF AMERICA,

By Oscar L Chapman

~~First~~ Assistant Secretary of the Interior, Lessor.

Thos. E. Barton

Lessee.

WITNESSES:

S W Scott, Denver, Colo.

Frances Reilly Denver, Colo

U. S. GOVERNMENT PRINTING OFFICE: 1934

Leases

TABLE I-1

Preference Right Lease Applications in Study Region

Applicant	Serial Number	Date of App. for Prospecting Permit	Acreage	Map Number
L. C. Craig	C 0125366	5-05-65	640.00	104
Ember Mining Co.	C 0126997	1-17-66	3,566.38	99
Ember Mining Co.	C 0126998	1-17-66	5,099.31	100
Ember Mining Co.	C 0126999	1-17-66	960.00	101
Phil Jenson & K. W. Miller	C 4275	6-20-68	2,071.76	98
Kemmerer Coal Co.	C 3606	3-12-68	2,984.17	78
Kemmerer Coal Co.	C 3605	3-12-68	2,984.44	79
Moonlake Electric Assoc.	C 8424	2-20-69	2,552.32	105
Moonlake Electric Assoc.	C 8425	2-20-69	560.00	106
Staley-Gordon Coal Co., Inc.	C 0126669	12-15-65	259.06	107
Utah International, Inc.	C 0123475	8-19-64	2,081.51	57
Total Acreage			23,758.95	

Recoverable Reserves (million tons):		
	Strippable	59.57
	Underground	686.16
	Total	745.73

Map Number refers to number designation on the Surface-Minerals Management Quads in Appendix A.

Leases

TABLE I-2

Competitive Lease Applications in Study Region

Applicant	Serial Number	Application Date	Acreage	Map Number
Coal Fuels Corp.	C 22546	3-20-75	6,960.00	110
Empire Energy Corp.	C 14738	12-17-71	7,105.00	49
Empire Energy Corp.	C 13134	6-18-71	240.00	55
Empire Energy Corp.	C 21981	9-17-74	974.07	3
Morgan Coal Co.	C 16284 1/	5-10-72	120.00	35
Energy Fuels Corp.	C 20900 1/	5-24-74	419.87	34
Morgan Coal Co.	C 9968 1/	11-10-69	320.00	68
James C. Goodwin	C 3440	1-30-68	604.75	14
Gossard, Inc.	C 16618	7-14-72	6,200.00	56
Peabody Coal Co.	C 19855	12-17-73	125.16	59
Moonlake Electric Assoc.	C 22654	4-30-75	12,680.00	111
Energy Fuels Corp.	C 22644 1/	4-30-75	678.01	112
Halandras Brothers	C 22628	4-21-75	640.00	113
Energy Fuels Corp.	C 22677 1/	4-30-75	604.26	114
W. R. Grace & Co.	C 22836	7-11-75	496.64	
W. R. Grace & Co.	C 22837	7-11-75	2,604.46	
W. R. Grace & Co.	C 22838	7-11-75	1,787.67	
W. R. Grace & Co.	C 22839 1/	7-11-75	379.56	
James D. Tatum	C 23055	9-16-75	3,758.19	
P. A. Burton	C 23081	10-20-75	11,250.68	
J. R. Roller & Assoc.	C 23082	9-22-75	619.53	
James D. Tatum	C 23096	9-25-75	4,590.57	
Energy Fuels	C 22676 1/	4-30-75	723.81	115
Peabody Coal Co.	C 22786	6-23-75	200.00	117
Utah International	C 3506	2-12-68	4,780.38	46
Empire Energy	C 14737	12-17-71	12,647.84	1
Empire Energy	C 14739	12-17-71	341.00	116
Commonwealth Coal	C 15846	3-07-72	480.00	109
Milner Coal Corp.	C 23230	10-30-75	40.00	
Blazer Fuels	C 23380	12-12-75	1,600.00	
Prosper Lombardi, Jr.	C 23396	6-22-76	80.00	
Colorado-Ute Electric Assoc.	C 23718	4-01-76	15,649.09	
Utah International	C 23909	5-13-76	401.00	
Total Acreage			100,101.54	

1/ Addressed as a site-specific proposal in this ES.

Map number refers to number designation on the Surface-Minerals Management Quads in Appendix A.

If no map number is shown, application was received after map was printed.

Leases

TABLE I-3

Issued Preference Right Leases in Study Region

Lessee	Serial Number	Map Number	Acreage	Application Date	Issuance Date	Expiration Date	Cumulative Production (1,000 tons)	Cumulative Rentals Royalties, and Bonuses
American Fuels Corp.	C 076713	94	320	1-17-62	2-1-66	2-1-86	26	4,100
Consolidation Coal Co.	C 093713	89	2,517.98	10-16-62	6-1-67	6-1-87		10,700
Consolidation Coal Co.	C 093714	90	1,458.00	10-16-62	6-1-67	6-1-87		6,200
Consolidation Coal Co.	C 093715	91	1,760.00	10-16-62	6-1-67	6-1-87		7,500
Consolidation Coal Co.	C 093716	92	2,060.91	10-16-62	6-1-67	6-1-87		8,700
Morgan Coal Co.	C 081330	32	2,215.28	4-26-62	11-1-63	11-1-83	226	55,000
Ferne James	C 064416	52	40.10	5-17-61	1-1-66	1-1-86		200
Gulf Oil Corp. (Pittsburg-Midway)	C 021601	23	826.94	4-3-58	6-1-62	6-1-82		7,600
Peabody Coal Co. (Mat. Serv. Corp.)	C 081251 1/	39	2,519.03	4-4-62	5-1-65	5-1-85		15,700
Peabody Coal Co. (Mat. Serv. Corp.)	C 081258 1/	40	2,323.44	4-6-62	5-1-65	5-1-85		14,500
Joe Petranovich (Routt Mining Co.)	D 052546	25	160	10-20-43	9-27-48	9-27-88	2	3,600
Paul Riebold	C 028875	102	1,675.22	5-7-59	11-1-63	11-1-83		13,800
Franklin Real Estate (Amer. Elec. Power)	C 012894	31	634.42	12-22-55	12-1-56	12-1-76	431	68,600
Utah International, Inc.	C 07519 2/	44	1,371.82	11-24-53	6-1-58	6-1-78		19,800
Utah International, Inc.	C 07518 2/	45	2,566.44	11-24-53	6-1-58	6-1-78		31,500
Utah International, Inc.	C 813	48	159.55	11-3-66	4-1-70	4-1-90		400
Utah International, Inc.	C 0123476	58	2,255.22	8-19-64	12-1-66	12-1-86		11,800
Morgan Coal	C 0128433 1/	33	474.93	6-22-66	6-1-75	6-1-95		
Moonlake Electric	C 023703	108	2,557.22	8-21-58	3-1-63	3-1-83		23,600
Totals			27,896.50				685	303,300

Recoverable Reserves (MM tons):	
Strippable	115.61
Underground	422.44
Total	538.05

Note: 1/ Addressed as a site-specific analysis in the Northwest Colorado Coal EIS.

2/ Environmental reporting for these leases completed prior to the initiation of this ES.

"Map Number" refers to number designation on the Surface-Minerals Management Quads in Appendix A.

"Application Date" is the date of application for pros.

"Issuance Date" is the date of original lease issuance.

"Expiration Date" is that next upcoming.

Leases

TABLE I-4

Issued Competitive Leases in Study Region

Lessee	Serial Number	Map Number	Acreage	Application Date	Issuance Date	Expiration Date	Cumulative Production (1,000 tons)	Cumulative Rentals Royalties, and Bonuses
Consolidation Coal Co.	C 245	62	225.86	8-2-66 [3]	10-1-66	10-1-86		1,900
Consolidation Coal Co.	C 1545	87	896.07	7-19-67 [3]	9-1-67	9-1-87		5,600
Consolidation Coal Co.	C 1546	88	1,096.73	7-19-67 [3]	9-1-67	9-1-87		7,200
Commonwealth Coal Co.	D 044240	93	160.00	8-5-31	1-12-33	[1]	126	20,800
Empire Energy Corp.	D 056298	2	41.21	4-23-48	12-1-49	12-1-89	69	11,200
Empire Energy Corp.	C 0127865	4	43.03	4-11-66	11-1-66	11-1-86		200
Morgan Coal Co.	D 052547 [2]	30	1,145.13	10-21-43	3-1-45	3-1-85	6,250	1,111,500
W. R. Grace	D 034365 [2]	20	2,564.73	4-8-24	10-25-24	10-25-84	3,413	440,400
Gulf Oil Corp. (Pittsburg-Midway)	D 041478	22	80.06	3-22-29	5-6-30	5-6-90	1,024	109,300
Gulf Oil Corp. (Pittsburg-Midway)	D 053710	24	89.04	12-12-45	6-10-47	6-10-87	172	27,400
Gulf Oil Corp. (Pittsburg-Midway)	D 033327	21	280.00	12-8-22	4-23-25	4-23-85	1,285	174,400
Maneotis Sheep Co.	D 051376	28	250.41	7-27-39	10-7-40	10-8-80	24	13,600
Peabody Coal Co.	C 088199	36	2,280.00	7-2-62	7-1-63	7-1-83	1,985	52,300
Peabody Coal Co.	C 086654	37	160.00	6-25-62	7-1-63	7-1-83	824	127,200
Peabody Coal Co.	C 0114093	38	1,320.00	10-21-63	5-1-64	5-1-84		24,100
Peabody Coal Co.	C 0125957	54	3,863.00	7-26-65	10-1-65	10-1-85		44,100
Reliable Coal	D 047201	103	513	1-23-35	7-25-36	6-25-76	182	29,600
Routt Mining Co.	C 0127592	26	80.00	3-7-66	10-1-66	10-1-86		800
Routt Mining Co.	D 046544	27	120.00	4-27-34	12-3-37	12-3-77	178	24,900
Utah International, Inc.	C 079641 [4]	43	1,351.84	3-21-62	10-1-62	10-1-82		13,900
Empire Energy Corp.	C 0126480	47	366.51	11-15-65 [3]	1-1-66	1-1-86		4,600
Ruby Construction	D 051698 [2]	29	146.26	10-28-40	9-11-41	9-11-81	10	4,600
Totals			17,072.88				15,539	2,249,600

Recoverable Reserves: (MM tons)
Strippable 79.67
Underground 241.67
Total 321.28

Note:

[1] Lease renewal in litigation

[2] Addressed as a site-specific analysis in the Northwest Colorado Coal EIS

[3] Indicates sale date

[4] Environmental reporting for development of this lease completed prior to the initiation of this ES.

"Issuance Date" is the date of original lease issuance.
"Expiration Date" is that next upcoming.
"Map Number" refers to number designation on the Surface-Minerals Management Quads in Appendix A.

Reclamation

APPENDIX D

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An Act

HOUSE BILL NO. 1065. BY REPRESENTATIVES Howe, Bendelow, Dittemore, Flanery, Flett, Lloyd, Lyon, Marks, Witherspoon, Arnold, Barragan, Boley, Brinton, Burrows, Cantrell, Castro, Dick, Eckelberry, Elliott, Frank, Friedman, Gaon, Gustafson, Hamlin, Hayes, Hilsmeier, Hogan, Knox, Kopel, Kramer, McCroskey, Massari, Miller, Neale, Orten, Sears, Shoemaker, Showalter, Spano, Sprague, Strahle, Taylor, Traylor, Valdez, Wayland, Webb, Wells, and Zakhem; also SENATORS Allshouse, Darby, Holme, Comer, Cooper, Groff, Kadlecek, MacManus, Smedley, and Stockton.

CONCERNING MINED LAND RECLAMATION.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Article 32 of title 34, Colorado Revised Statutes 1973, as amended, is REPEALED AND REENACTED, WITH AMENDMENTS, to read:

34-32-101. Short title. This article shall be known and may be cited as the "Colorado Mined Land Reclamation Act".

34-32-102. Legislative declaration. It is declared to be the policy of this state that the extraction of minerals and the reclamation of land affected by such extraction are both necessary and proper activities. It is further declared to be the policy of this state that both such activities should be and are compatible. It is the intent of the general assembly by the enactment of this article to allow for the continued development of the mining industry of this state, while requiring those persons involved in mining operations to reclaim land affected by such operations so that the affected land may be put to a use beneficial to the people of this state. It is the further intent of the general assembly by the enactment of this article to conserve natural resources, aid in the protection of wildlife and

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Capital letters indicate new material added to existing statutes; dashes through words indicate deletions from existing statutes and such material not part of act.

aquatic resources, and establish agricultural, recreational, residential, and industrial sites and to protect and promote the health, safety, and general welfare of the people of this state.

34-32-103. Definitions. As used in this article, unless the context otherwise requires:

(1) "Affected land" means the disturbed surface of an area within the state where a mining operation is being or will be conducted, including, but not limited to, on-site private ways, roads, and railroad lines appurtenant to any such area; land excavations; prospecting sites; drill sites or workings; refuse banks or spoil piles; evaporation or settling ponds; leaching dumps; placer areas; tailings ponds or dumps; work, parking, storage, or waste discharge areas; and areas in which structures, facilities, equipment, machines, tools, or other materials or property which result from or are used in such operations are situated. All lands shall be excluded that would be otherwise includable as land affected but which have been reclaimed in accordance with an approved plan or otherwise, as may be approved by the board.

(2) "Board" means the mined land reclamation board established by section 34-32-105.

(3) "Department" means the department of natural resources or such department, commission, or agency as may lawfully succeed to the powers and duties of such department.

(4) "Development" means the work performed in relation to a deposit, following the exploration required to prove minerals are in existence in commercial quantities but prior to production activities, aimed at, but not limited to, preparing the site for mining, defining further the ore deposit by drilling or other means, conducting pilot plant operations, constructing roads or ancillary facilities, and other related activities.

(5) "Executive director" means the executive director of the department of natural resources or such officer as may lawfully succeed to the powers and duties of such executive director.

(6) (a) "Life of the mine" means that a permit granted pursuant to section 34-32-110 or 34-32-115 may continue in effect as long as:

(I) An operator continues to engage in the extraction of minerals and complies with the provisions of this article.

(II) Mineral reserves are shown by the operator to remain in the mining operation and the operator plans to, or does, temporarily cease production for one hundred eighty days or more if he files a notice thereof with the board stating the reasons for nonproduction, a plan for the resumption thereof, and the measures taken to comply with reclamation and other necessary activities as established by the board to maintain the mine in a nonproducing state. The requirement of a notice of temporary cessation shall not apply to operators who resume operating within one year and have included, in their permit applications, a statement that the affected lands are to be used for less than one hundred eighty days per year.

(III) Production is resumed within five years of the date production ended, or the operator files a report requesting an extension of the period of temporary cessation of production with the board stating the reasons for the continuation of nonproduction and those factors necessary to, and his plans for, resumption of production. In no case shall temporary cessation of production be continued for more than ten years without terminating the operation and fully complying with the reclamation requirements of this article.

(IV) The board does not take action to declare termination of the life of the mine, which action shall require a sixty-day notice to the operator alleging a violation of, or that inadequate reasons are provided in an operator's report under subparagraph (I), (II), or (III) of this paragraph (a). In such cases, the board shall provide a reasonable opportunity for the operator to meet with the board to present the full case and further provide reasonable time for the operator to bring violations into compliance.

(b) "Life of the mine" includes that period of time after cessation of production necessary to complete reclamation of disturbed lands as required by the board and this article, until the board releases, in writing, the operator from further reclamation obligations regarding the affected land, declares the operation terminated, and releases the surety thereon.

(7) "Mineral" means an inanimate constituent of the earth in a solid, liquid, or gaseous state which, when extracted from the earth, is useable in its natural form or is capable of conversion into a useable form as a metal, a metallic compound, a chemical, an energy source, or a raw material for manufacturing or construction material. For the purposes of this article, this definition does not include surface or subsurface water, geothermal resources, or natural oil and gas together with other chemicals recovered therewith, but does include oil shale.

(8) "Mining operation" means the development or extraction of a mineral from its natural occurrences on affected land. The term includes, but is not limited to, open mining and surface operation and the disposal of refuse from underground and in situ mining. The term includes the following operations on affected lands: Transportation; concentrating; milling, evaporation; and other processing. The term does not include: The exploration

and extraction of natural petroleum in a liquid or gaseous state by means of wells or pipe; the extraction of geothermal resources; smelting, refining, cleaning, preparation, transportation, and other off-site operations not conducted on affected land.

(9) "Open mining" means the mining of minerals by removing the overburden lying above such deposits and mining directly from the deposits thereby exposed. The term includes mining directly from such deposits where there is no overburden. The term includes, but is not limited to, such practices as open cut mining, open pit mining, strip mining, quarrying, and dredging.

(10) "Operator" means any person, firm, partnership, association, or corporation, or any department, division, or agency of federal, state, county, or municipal government engaged in or controlling a mining operation.

(11) "Overburden" means all of the earth and other materials which lie above natural minerals and also means such earth and other materials disturbed from their natural state in the process of mining.

(12) "Prospecting" means the act of searching for or investigating a mineral deposit. "Prospecting" includes, but is not limited to, sinking shafts, tunneling, drilling core and bore holes and digging pits or cuts and other works for the purpose of extracting samples prior to commencement of development or extraction operations, and the building of roads, access ways, and other facilities related to such work. The term does not include those activities which cause no or very little surface disturbance, such as airborne surveys and photographs, use of instruments or devices which are hand carried or otherwise transported over the surface to make magnetic, radioactive, or other tests and measurements, boundary or claim surveying, location work, or other work which causes no greater land disturbance than is caused by ordinary lawful use of the land by persons not prospecting. The term also does not include any single activity which results in the disturbance of a single block of land totalling one thousand six hundred square feet or less of the land's surface, not to exceed two such disturbances per acre; except that the cumulative total of such disturbances will not exceed five acres statewide in any prospecting operation extending over twenty-four consecutive months.

(13) "Reclamation" means the employment during and after a mining operation of procedures reasonably designed to minimize as much as practicable the disruption from the mining operation and to provide for the rehabilitation of affected land through the rehabilitation of plant cover, soil stability, water resources, or other measures appropriate to the subsequent beneficial use of such mined and reclaimed lands.

(14) "Refuse" means all waste material directly connected with the cleaning and preparation of substances mined by a mining operation.

34-32-104. Administration. In addition to the duties and powers prescribed by the provisions of article 4 of title 24, C.R.S. 1973, the department has the full power and authority to carry out and administer the provisions of this article.

34-32-105. Mined land reclamation board - created. (1) There is hereby created, as a part of the office of the executive director, in the department of natural resources the mined land reclamation board.

(2) The board shall consist of seven members: The executive director, who shall serve as secretary to the board; a member of the state soil conservation board appointed by such board; and five persons appointed by the governor with the consent of the senate. Such appointed members shall be three individuals with substantial experience in agriculture or conservation, no more than two of whom shall have had experience in agriculture or conservation, and two individuals with substantial experience in the mining industry. Effective July 1, 1976, the terms of office of the existing members of the land reclamation board shall terminate, and, prior thereto, the governor shall appoint two members of the board, effective July 1, 1976, whose terms of office shall expire March 1, 1977, and three members of the board, effective July 1, 1976, whose terms of office shall expire March 1, 1979. Subsequent appointments shall be made for a term of four years. Vacancies shall be filled in the same manner as original appointments for the balance of the unexpired term. All members of the board shall be residents of the state of Colorado. Appointed members of the board shall receive no compensation for their service on the board but shall be reimbursed for necessary expenses incurred in the performance of their duties on the board. The board shall, by majority vote of all members, elect its chairman from among the appointed members at its first meeting in July, 1976, and the board shall elect its chairman from among the appointed members biannually thereafter.

(3) The board shall exercise its powers and perform its duties and functions specified in this article under the department as if the same were transferred to the department by a type 1 transfer as such transfer is defined in the "Administrative Organization Act of 1968", article 1 of title 24, C.R.S. 1973.

(4) The board shall have jurisdiction and authority over all persons and property, public and private, necessary to enforce the provisions of this article.

34-32-106. Duties of the board. (1) The board shall:

(a) Meet at least once each month;

(b) Carry on a continuing review of the problems of mining and land reclamation in the state of Colorado;

(c) Develop and promulgate standards for land reclamation plans and substitution of affected lands as provided in section 34-32-116;

(d) Cause to be published its monthly agenda with a brief description of affected land and name of the applicant. These publications shall be in a newspaper of general circulation in the locality of the proposed mining operations listed in that month's agenda.

(2) It is the duty of the department of agriculture, the department of higher education, the state soil conservation board, the Colorado geological survey, the division of parks and outdoor recreation, the division of wildlife, the university of Colorado, Colorado state university, Colorado school of mines, and the state forester to furnish the board and its designees, as far as practicable, whatever data and technical assistance the board may request and deem necessary for the performance of total reclamation and enforcement duties.

34-32-107. Powers of board. The board may initiate and encourage studies and programs through the department and in other agencies and institutions of state government relating to the development of less destructive methods of mining operations, better methods of land reclamation, more effective reclaimed land use, and coordination of the provisions of this article with the programs of other state agencies dealing with environmental, recreational, rehabilitation, and related concerns.

34-32-108. Rules and regulations. (1) The board may adopt and promulgate reasonable rules and regulations respecting the administration of this article and in conformity therewith.

(2) Except as provided in this article, no rule shall be issued nor existing rule amended by the board unless it is first submitted by the board to the attorney general for his opinion as to its constitutionality and legality and to the committee on legal services of the general assembly for its opinion as to the conformity of the rules to the legislative intent. The committee shall, on affirmative vote, submit such rules, comments, and resolutions as deemed appropriate to the legislative committees of reference at the next regular session of the general assembly; except that the initial rules and regulations proposed to be promulgated by the board under this article shall be submitted, with comment thereon as deemed appropriate, to the legislative committees of reference at the first regular session of the fifty-first general assembly. Such rules or any subsequent rules promulgated under this article or amendments thereto shall be in

effect until and unless the general assembly, acting by joint resolution, specifically disapproves all or any part of them, and only that portion of any rule specifically disapproved shall no longer be effective. Where the rule or amendment to an existing rule will have a fiscal impact on the state or any of its political subdivisions, the agency shall include a fiscal statement thereof with the rule or amendment submitted to the committee on legal services. Any rule or amendment to an existing rule issued by any agency without being so submitted to the attorney general and the committee on legal services shall be void.

34-32-109. Necessity of permit - application to existing permits. (1) Permits for mining operations shall be obtained as specified in this article.

(2) After June 30, 1976, any operator proposing to engage in a new mining operation must first obtain from the board a permit as specified in this article.

(3) (a) Applications for permits filed under the provisions of the "Colorado Open Mining Reclamation Act of 1973" prior to and pending on July 1, 1976, shall be processed in accordance with the provisions of this article. Permits granted under the provisions of the "Colorado Open Mining Reclamation Act of 1973" prior to July 1, 1976, are valid permits for the purposes of this article and are subject to the provisions of this article for the purpose of renewal. An application for renewal shall be filed at least ninety days prior to the expiration of the permit. Such applications shall be in accordance with section 34-32-112; except that the applicant need not supply information, materials, and undertakings previously supplied. The application for renewal of a permit shall show the area mined or disturbed and the area reclaimed since the original permit or the last renewal.

(b) (I) An operator with an existing permit granted under the provisions of the "Colorado Open Mining Reclamation Act of 1973" may apply for the conversion of his existing permit to a permit for the life of the mine under the provision for renewal set forth in this subsection (3) at any time on or after July 1, 1976. The fee for the conversion of such an existing permit shall not exceed one hundred dollars if the conversion is made during the first year of the permit.

(II) Thereafter, the provisions of section 34-32-112 (6) shall apply; except that the fee shall not exceed five hundred dollars for conversion during the second year of the permit, one thousand dollars for conversion during the third year of the permit, one thousand five hundred dollars for conversion during the fourth year, and two thousand dollars thereafter.

(4) Mining operations which were lawfully being conducted prior to July 1, 1976, without a permit may continue to be so

conducted until October 1, 1977, if, between July 1, 1976, and October 1, 1977, the operators of such existing mining operations apply for a permit as specified in this article. Any such operator, having made application by October 1, 1977, but not having received a permit by that date, shall be permitted to continue his mining operation until such permit is either granted or denied. Any such operator who is denied a permit and continues operations after such denial or who has not applied for a permit by October 1, 1977, and continues operations after October 1, 1977, shall be considered in violation of this article and subject to the provisions of section 34-32-123. An operator of an existing operation who is in compliance with all requirements of the statutes in effect prior to July 1, 1976, and the rules, regulations, and orders issued thereunder, and any applicable stabilization and reclamation agreements shall not be denied a permit if he provides such bond and undertakes such new reclamation program as may reasonably be required in relation to his existing operation, pursuant to the provisions of this article.

(5) Permits granted pursuant to applications, including applications for renewal, filed after June 30, 1976, shall be effective for the life of the particular mining operation if the operator complies with the conditions of such permits and with applicable statutes, rules, and regulations.

(6) No governmental office of the state, other than the board, nor any political subdivision of the state shall have the authority to issue a permit. However, the board shall not grant a permit in violation of city, town, county, or city and county zoning or subdivision regulations or contrary to any master plan for extraction adopted pursuant to section 34-1-304 unless a prior declaration of intent to change or waive the prohibition is obtained by the applicant from the affected government subdivisions.

(7) An operator shall obtain a development and extraction permit from the board for each mining operation.

(8) The board shall not grant a permit for a new mining operation if the operator's reclamation plan for an area is inconsistent with an adopted plan by any county, city and county, city, or town unless a prior declaration of intent to change or waive the prohibition is obtained by the applicant from the affected government subdivisions. However, the operator shall not be required to install improvements to or on the area reclaimed. After the filing of any application for a permit under this article, the board shall notify each county in which the area proposed to be mined is located and each municipality located within two miles of the area to be mined of the filing of the application.

34-32-110. Limited impact operations. (1) Any mining operation which affects less than ten acres and extracts less than seventy thousand tons of mineral or overburden per calendar year shall be subject to the provisions of this section. Any new or existing underground mining operation being conducted on previously mined land with existing unreclaimed land disturbance shall not be required to reclaim such existing unreclaimed land disturbance which was incurred by a previous operator.

(2) The operator shall obtain a permit from the board by filing an application with the board that shall set forth the following information:

(a) The address of the general office and the local address or addresses of the operator;

(b) The name of the owner of the surface of the affected land;

(c) The name of the owner of the subsurface rights of the affected land;

(d) A map showing information sufficient to determine the location of the affected land on the ground and existing and proposed roads or access routes to be used in connection with the mining operation;

(e) The approximate size of the affected land;

(f) Information sufficient to describe or identify the type of mining operation proposed and how it would be conducted; and

(g) The measures to be taken to comply with the applicable provisions of section 34-32-116 (1) (b) to (1) (r).

(3) A fee of twenty-five dollars, plus ten dollars for each acre of affected land and such surety not to exceed two thousand five hundred dollars as the board shall determine, shall accompany the application and shall be paid by the applicant. In the event of permit denial, seventy-five percent of the fee shall be refunded. If the refund will be thirty-five dollars or less, no refund shall be made.

(4) Except as provided in section 34-32-103 (6) (a) (II), the operator shall annually file on the anniversary date of the permit a notice of intent to continue mining operations. The notice of intent shall contain an annual fee of fifty dollars and a map or statement that shall indicate:

(a) The land affected during the preceding year;

(b) The land to be affected during the coming year; and

(c) Any land reclaimed during the preceding year.

(5) The operator, at any time after the completion of reclamation, may notify the board that the land has been reclaimed. Upon receipt of the notice that the affected land or a portion of it has been reclaimed, the board shall cause the land to be inspected and release the surety or a portion of it within thirty days after the board finds the reclamation to be satisfactory and in accordance with a plan agreed upon by the board and the operator.

(6) After June 30, 1976, any operator proposing to engage in a new mining operation as provided in subsection (1) of this section shall file a permit application to engage in mining thirty days prior to the start of the mining operation. Mining operations which were lawfully conducted prior to July 1, 1976, may continue to be so conducted if the operator files with the board a permit application. Any reclamation permit issued to a mining operator prior to July 1, 1976, under the provisions of the "Colorado Open Mining Reclamation Act of 1973" shall remain in force until such time as it expires and shall be deemed adequate for the purposes of this article. At the expiration of such reclamation permits, the operator shall file a notice of intent in the manner provided for in subsection (4) of this section thirty days prior to the expiration of the permit, and, unless the board finds that the operator has not complied with the terms of his existing permit, the board shall grant the operator a new permit for the life of the mine.

(7) Applications for permits under this section shall be processed and final action taken thereon within thirty days of the filing thereof. If action upon the application is not completed within the thirty-day period specified in this subsection (7), the permit shall be considered to be approved and shall be promptly issued upon presentation by the applicant of surety in the amount provided in subsection (3) of this section. The provisions of sections 34-32-112, 34-32-114, and 34-32-115 concerning publication, notice, written objections, petitions, and supporting documents shall so far as practicable apply to this section, but the board shall, by regulation, provide simplified and reduced procedures and requirements therefor which are applicable to meet said thirty-day period. Within said thirty-day period, the board, at its discretion, may hold a hearing on an application as provided in sections 34-32-114 and 34-32-115.

(8) (a) Any operator conducting an operation under a permit issued under this section, who has held the permit for two consecutive years or more, and who subsequently desires to expand it to a size in excess of the limitation set forth in subsection (1) of this section may request the conversion of his permit by filing an application for a permit pursuant to section 34-32-112; except that the applicant need not supply information, materials, and other data and undertakings previously supplied, including any additional applicable materials provided the board during the

course of his current operation, or resulting from the board's inspections thereof.

(b) Applications for conversion of a permit under this subsection (8) shall be processed and final action taken thereon within ninety days of the filing thereof. If action upon the conversion of the permit is not completed with the ninety-day period, the conversion should be deemed approved, and a permit for the life of the mine shall be promptly issued upon presentation by the applicant of surety in the amount of two thousand dollars per acre of affected land.

(c) The provisions of sections 34-32-112, 34-32-114, and 34-32-115 concerning publication, notice, written objections, petitions, and supporting documents shall so far as practicable apply to this section; but the board shall, by regulation, provide procedures and requirements therefor which are applicable to meet said ninety-day period.

(d) The board shall not deny the conversion of a permit for any reason other than those set forth in section 34-32-115 (4).

34-32-111. Special permits - ten-day processing. (1) Any sand, gravel, or quarry aggregate operation which is to be operated for the sole purpose of obtaining materials for highway, road, utility, or similar-type construction under a federal, state, county, city, town, or special district contract where the contract calls for work to be commenced within a specifically short time and which will affect ten acres or less shall be subject to the provisions of this section.

(2) The operator shall make written application to the board for a special permit on forms provided by the board. The approved special permit shall authorize the operator to engage in such mining operation until the governmental contractual reason for the operation is complete. Such application shall consist of the following:

(a) Two application forms;

(b) Two copies of an accurate map of the affected land submitted with each of the applications. This map shall be prepared by a registered land surveyor, professional engineer, or other qualified person. The map shall show information sufficient to determine the location of the affected land on the ground and existing and proposed roads or access routes to be used in connection with the mining operation.

(c) The application fee of two hundred dollars plus fifteen dollars per acre affected; and

(d) Surety or bond in the amount of two thousand five hundred dollars per acre.

(3) Each application form shall include:

(a) The name and address of the general office and the local address or addresses of the operator;

(b) The name and address of the owner of the surface of the affected land;

(c) The name and address of the owner of the subsurface rights of the affected land;

(d) The approximate size of the affected land;

(e) Information sufficient to describe or identify the type of mining operation proposed and how it would be conducted;

(f) The measures to be taken to comply with the applicable provisions of section 34-32-116 (1) (b) to (1) (r);

(g) The terms of the governmental contract which make a special permit necessary;

(h) The surety provided under the governmental contract; and

(i) A certificate of compliance, by the local government having jurisdiction, that the mining operation would be in compliance with zoning, subdivision regulations, and any master plan for extraction adopted pursuant to section 34-1-304 unless a prior declaration of intent to change or waive the prohibition is obtained by the applicant from the affected local government.

(4) If the board determines that any of the proposed affected land lies within the boundaries of lands described in section 34-32-115 (4) (f), that land shall be withdrawn from the operation.

(5) The operator, at any time after the completion of reclamation, may notify the board that the land has been reclaimed. Upon receipt of the notice that the affected land or a portion of it has been reclaimed, the board shall cause the land to be inspected and release the surety or a portion of it within thirty days after the board finds the reclamation to be satisfactory and in accordance with a plan agreed to by the board and the operator.

(6) The board and staff shall take action on these special permits so that they shall be issued within ten working days of the date the application is submitted. Approval shall depend on the application, map, fee, and surety all being in proper order and in compliance with this section.

(7) In the case where a governmental subdivision, acting as

an operator, requires a permit solely for the purpose of mining construction materials for the construction of public roads under a contract with the state department of highways, or otherwise, the governmental subdivision shall be exempted from the requirements of paragraphs (c) and (d) of subsection (2) of this section. In the case where an operator requires a permit solely for the purpose of mining construction materials to fulfill a contract with the state department of highways, he shall be exempted from the requirements of paragraph (c) of subsection (2) of this section after he has complied with the other provisions of this section.

34-32-112. Application for permit - bond - fee - notice. (1) Any operator desiring to obtain a permit shall make written application to the board for a permit on forms provided by the board. The permit or the renewal of an existing permit, if approved, shall authorize the operator to engage in such mining operation upon the affected land described in his application for the life of the mine. Such application shall consist of the following:

(a) Five copies of the application;

(b) A reclamation plan submitted with each of the applications;

(c) An accurate map of the affected land submitted with each of the applications;

(d) The application fee.

(2) The application forms shall state:

(a) The legal description and area of affected land;

(b) The owner of the surface of the area of affected land;

(c) The owner of the substance to be mined;

(d) The source of the applicant's legal right to enter and initiate a mining operation on the affected land;

(e) The address and telephone number of the general office and the local address and telephone number of the applicant;

(f) The detailed description of the method of mining to be employed;

(g) The size of the area to be worked at any one time;

(h) The timetable estimating the periods of time which will be required for the various stages of the mining operation.

(3) The reclamation plan shall be based upon provisions for, or satisfactory explanation of, all general requirements for the type of reclamation proposed to be implemented by the operator. Reclamation shall be required on all the affected land. The reclamation plan shall include:

(a) A description of the types of reclamation the operator proposes to achieve in the reclamation of the affected land, why each was chosen, and the amount of acreage accorded to each;

(b) A description of how the reclamation plan will be implemented to meet the requirements of section 34-32-116;

(c) A proposed timetable indicating when and how the reclamation plan shall be implemented;

(d) A description of how the reclamation plan will rehabilitate the affected land. This description shall include, but not be limited to, natural vegetation, wildlife, water, air, and soil.

(e) A map of all of the proposed affected land by all phases of the total scope of the mining operation. It shall indicate the following:

(I) The expected physical appearance of the area of the affected land, correlated to the proposed timetables required by paragraph (h) of subsection (2) of this section and paragraph (c) of this subsection (3); and

(II) Portrayal of the proposed final land use for each portion of the affected lands.

(4) The accurate map of the affected lands shall:

(a) Be made by a registered land surveyor, professional engineer, or other qualified person;

(b) Identify the area which corresponds with the application;

(c) Show adjoining surface owners of record;

(d) Be made to a scale of not less than one hundred feet to the inch and not more than six hundred sixty feet to the inch;

(e) Show the name and location of all creeks, roads, buildings, oil and gas wells and lines, and power and communication lines on the area of affected land and within two hundred feet of all boundaries of such area;

(f) Show the total area to be involved in the operation, including the area to be mined and the area of affected land;

(g) Show the topography of the area with contour lines of sufficient detail to portray the direction and rate of slope of the affected land in question;

(h) Indicate on a map or by a statement the general type, thickness, and distribution of soil over the area in question, including the affected land;

(i) Show the type of present vegetation covering the affected land.

(5) The reclamation plan shall also show by statement or map the depth and thickness of the ore body or deposit to be mined and the thickness and type of the overburden to be removed.

(6) A basic fee of fifty dollars and, in addition, a fee of fifteen dollars per acre for the first fifty acres, ten dollars per acre for the second fifty acres, five dollars per acre for the third fifty acres, and one dollar per acre for any additional acres shall be paid. In no case shall the permit fee exceed two thousand dollars. A fraction of an acre shall be considered a full acre for computing the fee. In the event of permit denial, seventy-five percent of the permit fee shall be refunded. If the refund will be two hundred dollars or less, no refund shall be made.

(7) Each phase of reclamation is to be completed within five years after the date the operator advises the board that such phase has commenced, as provided in the introductory portion of section 34-32-116 (1) (r); except that such period may be extended by the board upon a finding that additional time is necessary for the completion of the terms of the reclamation plan.

(8) An operator may, within the term of a permit, apply to the board for a permit renewal or for an amendment to the permit increasing or decreasing the acreage to be affected or otherwise revising the mining operation. Where applicable, there shall be filed with any application for amendment a map and an application with the same content as required for an original application. The renewed or amended application shall be accompanied by a basic fee of twenty-five dollars plus seven dollars and fifty cents per acre for the first fifty acres, five dollars per acre for the second fifty acres, two dollars and fifty cents per acre for the third fifty acres, and fifty cents per acre for each additional acre. In no case shall the renewal or amendment fee be less than one hundred dollars or more than one thousand dollars. A fraction of an acre shall be considered a full acre for the purpose of computing the fee. In addition, a supplemental surety, as determined by the board, for any additional acreage shall be submitted. If the area of the original application is reduced, the amount of the surety, as determined by the board, shall proportionately be reduced.

Renewal applications shall contain the information required in the original application if different from that in the original application or renewal. The renewal permit shall show the area mined or disturbed and the area reclaimed since the original permit or the last renewal. Applications for renewal or amendment of a permit shall be reviewed by the board in the same manner as applications for new permits.

(9) Information provided the board in an application for a permit relating to the location, size, or nature of the deposit or information required by subsection (5) of this section and marked confidential by the operator shall be protected as confidential information by the board and not be a matter of public record in the absence of a written release from the operator or until such mining operation has been terminated. A person who willfully and knowingly violates the provisions of this subsection (9) and section 34-32-113 (3) commits a class 2 misdemeanor and shall be punished as provided in section 18-1-106, C.R.S. 1973.

(10) (a) Upon the filing of his application for a permit with the board, the applicant shall file a copy of such application for public inspection at the office of the board and in the office of the county clerk and recorder of the county in which the affected land is located. The information exempted by subsection (9) of this section shall be deleted from such file copies.

(b) The applicant shall cause notice of the filing of his application to be published in a newspaper of general circulation in the locality of the proposed mining operation once a week for four consecutive weeks, commencing not more than ten days after the filing of his application with the board. Such notice shall contain information regarding the identity of the applicant, the location of the proposed mining operation if such information does not violate the provisions of subsection (9) of this section, the proposed dates of commencement and completion of the operation, the proposed future use of the affected land, the location where additional information about the operation may be obtained, and the location and final date for filing objections with the board.

(c) In addition, the applicant shall mail a copy of such notice immediately after first publication to all owners of the surface rights of the affected land, to the owners of record of immediately adjacent lands, and to any other persons who are owners of record that may be designated by the board which might be affected by the proposed mining operation. Proof of such notice and mailing, such as certified mail with return receipt requested where possible, shall be provided the board and become part of the application.

34-32-113. Prospecting notice - reclamation requirements.

(1) Any person desiring to conduct prospecting shall, prior to entry upon the lands, file with the board a notice of intent to conduct prospecting operations on a form approved by the board.

(2) The notice form shall contain the following:

(a) The name of the person or organization doing the prospecting;

(b) A statement that prospecting will be conducted pursuant to the terms and conditions listed on the approved form;

(c) A brief description of the type of operations which will be undertaken;

(d) A description of the lands to be prospected by township and range;

(e) An approximate date of commencement of operations; and

(f) Measures to be taken to reclaim any affected land consistent with the requirements of section 34-32-116.

(3) All information provided the board in a notice of intent to conduct prospecting shall be protected as confidential information by the board and not be a matter of public record in the absence of a written release from the operator or upon a finding by the board that reclamation is satisfactory, whichever may first occur.

(4) Upon filing the notice of intent to conduct prospecting, the person shall post surety in an amount determined by the board not to exceed two thousand dollars per acre of the land to be disturbed or shall post a surety of twenty-five thousand dollars for statewide prospecting. If a statewide prospecting surety is posted, the person posting the surety must otherwise comply with the provisions of this section for every area to be prospected.

(5) Upon completion of the prospecting, there shall be filed with the board a notice of completion of prospecting operations. Within ninety days after the filing of the notice of completion, the board shall notify the person who had conducted the prospecting operations of the steps necessary to reclaim the land.

(6) The board shall inspect the lands prospected within thirty days after the person prospecting the lands completes the reclamation and notifies the board that the reclamation is finished. If the board finds the reclamation satisfactory, the board shall release the surety.

(7) The surety shall not be held for more than thirty days

after the completion of the reclamation.

34-32-114. Protests and petitions for a hearing. Any person has the right to file written objections to or statements in support of an application for a permit with the board. Such protests or petitions for a hearing shall be timely filed with the board not more than twenty days after the date of last publication of notice pursuant to section 34-32-112 (10). For good cause shown in the protest or petition documents, the board, in its discretion, may hold a hearing pursuant to section 34-32-115 on the question of whether the permit should be granted. The applicant shall be notified within ten days of any objections to his application and be supplied with a copy of the written objections.

34-32-115. Action by board - appeals. (1) Upon receipt of an application for a permit and all fees due from the operator, the board shall set a date for the consideration of such application not more than ninety days after the date of filing. At that time the board shall approve or deny the application or, for good cause shown, hold a hearing on the question of whether the permit should be granted.

(2) Prior to the holding of any such hearing, the board shall provide notice to any person previously filing a protest or petition for a hearing or statement in support of an application pursuant to section 34-32-114 and shall publish notice of the time, date, and location of the hearing in a newspaper of general circulation in the locality of the proposed mining operation once a week for two consecutive weeks immediately prior to the hearing. The hearing shall be conducted as a proceeding pursuant to article 4 of title 24, C.R.S. 1973. A final decision on the application shall be made within one hundred twenty days of the receipt of the application. In the event of serious unforeseen circumstances or significant snow cover on the affected land that prevents a necessary on-site inspection, the board may reasonably extend the maximum time sixty days.

(3) If action upon the application is not completed within the one-hundred-twenty-day period specified in subsection (2) of this section, the permit shall be considered to be approved and shall be promptly issued upon presentation by the applicant of surety in the amount of two thousand dollars per acre affected.

(4) The board shall grant a permit to an operator if the application complies with the requirements of this article and all applicable local, state, and federal laws. The board shall not deny a permit, except for one or more of the following reasons:

(a) The application is incomplete or the surety has not been posted.

(b) The applicant has not paid the required fee.

(c) Any part of the proposed mining operation, the reclamation program, or the proposed future use is contrary to the laws or regulations of this state or the United States.

(d) The mining operation will adversely affect the stability of any significant, valuable, and permanent man-made structures located within two hundred feet of the affected land, except where there is an agreement between the operator and the persons having an interest in the structure that damage to the structure is to be compensated for by the operator.

(e) The mining operation would be in violation of any city, town, county, or city and county zoning or subdivision regulations or contrary to any master plan for extraction adopted pursuant to section 34-1-304.

(f) The mining operation is located upon lands:

(I) Where mining operations are prohibited by law or regulation within the boundaries of units of the national park system, the national wildlife refuge system, the national system of trails, the national wilderness preservation system, the wild and scenic rivers system, or national recreation areas;

(II) Which are within or without the boundaries of, and are owned, leased, or have been developed by, any recreational facility established pursuant to article 7 of title 29, C.R.S. 1973, unless otherwise authorized by the appropriate governing body or unless the operation will not create any surface disturbance therein;

(III) Which are within the boundaries of, and are owned, leased, or have been developed by, any recreation district established pursuant to article 2 of title 32, C.R.S. 1973, unless otherwise authorized by the board of directors of the district or unless the operation will not create any surface disturbance therein; and

(IV) Which are within the boundaries of any unit of the state park system or any state recreational area in which the entire fee estate is owned by the state of Colorado, unless the mining operation is approved jointly by the board, by the governor, and by the board of parks and outdoor recreation, or unless the operation will not create any surface disturbance therein.

(g) The proposed mining operation and reclamation could not be carried out in conformance with the requirements of section 34-32-116.

34-32-116. Duties of operator. (1) Every operator to whom a permit is issued pursuant to the provisions of this article may engage in the mining operation upon the affected lands described in the permit, upon the performance of and subject to the following requirements with respect to such lands:

(a) On the anniversary date of the permit each year, the operator shall submit a reclamation plan and map showing the affected land and other pertinent details, such as roads and access to the area and reclamation accomplished. All maps shall show quarter-section, section, township, and county lines within the scope of the map, access to the area from the nearest public road, a meridian, a title containing the name of the operator and his address, the scale of the map, the name of the person or engineer who prepared the map, the date, and the township, range, and county. The reclamation plan prepared by the operator shall be based upon provisions for, or satisfactory explanation of, all general requirements for the type of reclamation chosen. The details of the plan shall be appropriate to the type of reclamation designated by the operator and based upon the advice of technically trained personnel experienced in that type of reclamation on affected lands and upon scientific knowledge from research in reclaiming and utilizing such lands. Except for operators having permits under section 34-32-110, the operator shall submit, in addition to the plan and map, an annual fee of three hundred fifty dollars if the operation is an open mining operation or two hundred seventy-five dollars for any other operation.

(b) Grading shall be carried on so as to create a final topography appropriate to the final land use selected in accordance with paragraph (k) of this subsection (1).

(c) Earth dams shall be constructed, if necessary to impound water, if the formation of such impoundments will not interfere with mining operations, damage adjoining property, or conflict with water pollution laws, rules or regulations of the federal government, or the state of Colorado, or any local government pollution ordinances.

(d) Acid-forming or toxic-producing material that has been mined shall be handled in a manner that will protect the drainage system from pollution.

(e) All refuse shall be disposed in a manner that will control unsightliness, or deleterious effects from such refuse.

(f) In those areas where revegetation is part of the reclamation plan, land shall be revegetated in such a way as to establish a diverse, effective, and long-lasting vegetative cover that is capable of self-regeneration and at least equal in extent of cover to the natural vegetation of the surrounding area. Native species should receive first consideration, but introduced species may be used in the revegetation process when found desirable by the board.

(g) Where it is necessary to remove overburden in order to mine the mineral, topsoil shall be removed from the affected land and segregated from other spoil. If such topsoil is not replaced on a backfill area within a time short enough to avoid deterioration of the topsoil, vegetative cover or other means shall be employed so that the topsoil is preserved from wind and water erosion, remains free of any contamination by other acid or toxic material, and is in a useable condition for sustaining vegetation when restored during reclamation. If, in the discretion of the board, such topsoil is of insufficient quantity or of poor quality for sustaining vegetation or if other strata can be shown to be more suitable for vegetation requirements, the operator shall remove, segregate, and preserve in a like manner such other strata which are best able to support vegetation.

(h) Disturbances to the prevailing hydrologic balance of the affected land and of the surrounding area and to the quality and quantity of water in surface and ground water systems both during and after the mining operation and during reclamation shall be minimized.

(i) Areas outside of the affected land shall be protected from slides or damage occurring during the mining operation and reclamation.

(j) All surface areas of the affected land, including spoil piles, shall be stabilized and protected so as to effectively control erosion and attendant air and water pollution.

(k) On all affected land, the operator in consultation with the landowner where possible, subject to the approval of the board, shall determine which parts of the affected land shall be reclaimed for forest, range, crop, horticultural, homesite, recreational, industrial, or other uses, including food, shelter, and ground cover for wildlife. Prior to approving any new reclamation plan or approving a change in any existing reclamation plan as provided in this section, the board shall confer with the local board of county commissioners and the board of supervisors of the soil conservation district if the mining operation is within the boundaries of a soil conservation district. Reclamation shall be required on all the affected land.

(l) If the operator's choice of reclamation is forest planting, he may, with the approval of the department, select the type of trees to be planted. Planting methods and care of stock shall be governed by good planting practices. If the operator is unable to acquire sufficient planting stock of desired tree species from the state or elsewhere at a reasonable cost, he may defer planting until planting stock is available to plant such land as originally planned, or he may select an alternate method of reclamation.

(m) The operator shall construct fire lanes or access roads when necessary through the area to be planted. These lanes or roads shall be available for use by the planting crews and shall serve as a means of access for supervision and inspection of the planting work.

(n) On lands owned by the operator, the operator may permit the public to use the same for recreational purposes, in accordance with the limited landowner liability law contained in article 41 of title 33, C.R.S. 1973, except in areas where such use is found by the operator to be hazardous or objectionable.

(o) If the operator's choice of reclamation is for range, the affected land shall be restored to the satisfaction of the board to slopes commensurate with the proposed land use and shall not be too steep to be traversed by livestock. The legume seed shall be properly inoculated in all cases. The area may be seeded either by hand, or power, or by the aerial method. The species of grasses and legumes and the rates of seeding to be used per acre shall be determined primarily by recommendations from the agricultural experiment stations established pursuant to article 33 of title 23, C.R.S. 1973, and experienced reclamation personnel of the operator, after considering other research or successful experience with range seeding. No grazing shall be permitted on reclaimed land until the planting is firmly established. The board, in consultation with the landowner and the local soil conservation district, if any, shall determine when grazing may start.

(p) If the operator's choice of reclamation is for agricultural or horticultural crops which normally require the use of farm equipment, the operator shall grade so that the area can be traversed with farm machinery. Preparation for seeding or planting, fertilization, and seeding or planting rates shall be governed by general agricultural and horticultural practices, except where research or experience in such operations differs with these practices.

(q) If the operator's choice of reclamation is for the development of the affected land for homesite, recreational, industrial, or other uses, including food, shelter, and ground cover for wildlife, the basic minimum requirements necessary for such reclamation shall be agreed upon by the operator and the board.

(r) All reclamation provided for in this section shall be carried to completion by the operator with all reasonable diligence, and each phase of reclamation shall be completed prior to the expiration of five years after the date on which the operator advises the board that such phase has commenced, unless such period is extended by the board pursuant to section

34-32-112 (7); except that:

(I) No planting of any kind shall be required to be made on any affected land being used or proposed to be used by the operator for the deposit or disposal of refuse until after the cessation of operations productive of such refuse, or proposed for future mining, or within depressed haulage roads or final cuts while such roads or final cuts are being used or made, or where permanent pools or lakes have been formed;

(II) No planting of any kind shall be required on any affected land so long as the chemical and physical characteristics of the surface and immediately underlying material of such affected land are toxic, deficient in plant nutrients, or composed of sand, gravel, shale, or stone to such an extent as to seriously inhibit plant growth and such condition cannot feasibly be remedied by chemical treatment, fertilization, replacement of overburden, or like measures. Where natural weathering and leaching of any of such affected land, over a period of ten years after commencement of reclamation, fails to remove the toxic and physical characteristics inhibitory to plant growth or if, at any time within such ten-year period, the board determines that any of such affected land is, and during the remainder of said ten-year period will be, unplantable, the operator's obligations under the provisions of this article with respect to such affected land may, with the approval of the board, be discharged by reclamation of an equal number of acres of land previously mined and owned by the operator not otherwise subject to reclamation under this article.

(III) With the approval of the board and the owner of the land to be reclaimed, the operator may substitute land previously mined and owned by the operator not otherwise subject to reclamation under this article or, in the alternative, with the approval of the board and the owner of the land, reclamation of an equal number of acres of any lands previously mined but not owned by the operator if the operator has not previously abandoned unreclaimed mining lands. The board also has authority to grant in the alternative the reclamation of lesser or greater acreage so long as the cost of reclaiming such acreage is at least equivalent to the cost of reclaiming the original permit lands. If any area is so substituted, the operator shall submit a map of the substituted area, which map shall conform to all of the requirements with respect to other maps required by this article. Upon completion of reclamation of the substituted land, the operator shall be relieved of all obligations under this article with respect to the land for which substitution has been permitted.

(IV) Reclamation may be completed in phases, and the five-year period may be applied separately to each phase as it is commenced during the life of the mine.

34-32-117. Surety of operator - amount - sufficiency of surety - violations - compliance. (1) (a) In determining the amount and duration of surety to be required, the board shall consider factual information as to the magnitude, type, and costs of reclamation activities planned for the affected land and the nature, extent, and duration of the mining operation.

(b) In determining the form of surety to be provided by the operator if other than a bond, the board shall consider, with respect to the operator, such factors as his financial status, his assets within the state, his past performance on contractual agreements, and his facilities available to carry out the planned work. The operator shall supply evidence of financial responsibility for all surety other than a bond.

(c) Liability of an operator under surety provisions shall continue until such time as released in part or in its entirety by the board. In no case shall surety be held more than twelve months after completion of reclamation.

(d) Surety in an amount and form as determined by the board shall be provided by the operator prior to the issuance of a permit pursuant to sections 34-32-112 and 34-32-115.

(2) Any surety required under this article to be filed by the operator shall be in such form as the board prescribes, payable to the state of Colorado, conditioned that the operator shall faithfully perform all requirements of this article and comply with all rules and regulations made in accordance with the provisions of this article. Such surety shall be signed by the operator as principal and, if required, by a good and sufficient corporate surety authorized to do business in this state. The penalty of such surety shall be in such amount as the board deems necessary to insure the performance of the duties of the operator under this article with respect to the affected land. If a county or municipality requires, in the opinion of the board, an adequate reclamation plan and a surety sufficient to carry out that plan, evidence of such plan and surety shall be acceptable to the board. In lieu of such surety, the operator may deposit cash and government securities with the board in an amount equal to that of the required surety on conditions as prescribed in this subsection (2). In the discretion of the board, surety requirements may also be fulfilled by using other lands, property, or existing reclaimed areas if owned by the operator in excess of cumulative acres that have been reclaimed under the provisions of this article and approved by the board. The penalty of the surety or amount of cash and securities shall be increased or reduced from time to time as provided in this article. Such surety or security shall remain in effect until the affected land has been reclaimed, approved, and released by the board. The board shall have all powers necessary to foreclose upon all real estate provided as surety, to dispose of the real estate, and to apply the proceeds of the disposed real

estate to the reclamation of lands not reclaimed by the operator who supplied the real estate as surety.

(3) A surety shall not be cancelled by the surety without giving at least sixty days' notice to the board prior to the anniversary date of its intent to limit exposure to existing circumstances as of the next anniversary date. In the event the surety is cancelled, the operator shall provide substitute surety covering operations or post cash surety in lieu thereof within thirty days after receipt of such notification, to take effect upon the cancellation date of the previous surety.

(4) If the license to do business in this state of any corporate surety upon a surety filed with the board pursuant to this article is suspended or revoked, the operator, within sixty days after receiving notice thereof from the board, shall substitute for such surety a good and sufficient corporate surety licensed to do business in the state. Upon failure of the operator to make substitution of surety, the board has the right to suspend the permit of the operator to conduct operations upon the land described in such permit until such substitution has been made.

(5) The board has the power to reclaim, in accordance with the provisions of this article, any affected land with respect to which a surety has been forfeited.

(6) Whenever an operator has completed all requirements under the provisions of this article as to any affected land or segment thereof, he shall notify the board in writing. If the board releases the operator from further obligations regarding such affected land, the penalty of the surety shall be reduced proportionately.

34-32-118. Surety forfeiture proceedings - prerequisites - penalties. The attorney general, upon request of the board, shall institute proceedings to have the surety of the operator forfeited for violation by the operator of an order entered pursuant to section 34-32-124. Before making such request of the attorney general, the board shall notify the operator in writing of the alleged violation of or noncompliance with such order and shall afford the operator the right to appear before the board at a hearing to be held not less than thirty days after the receipt of such notice by the operator. At the hearing the operator may present for the consideration of the board statements, documents, and other information with respect to the alleged violation. After the conclusion of the hearings, the board shall either withdraw the notice of violation or shall request the attorney general to institute proceedings to have the surety of the operator forfeited as to the land involved.

34-32-119. Operators - succession. Where one operator succeeds another at any uncompleted operation, the board shall release the first operator from all liability as to that particular reclamation operation and shall release his surety as to such operation if the successor operator assumes, as part of his obligation under this article, all liability for the reclamation of the affected land, and his obligation is covered by an appropriate surety as to such affected land.

34-32-120. Permit refused defaulting operator. No permit for new mining operations shall be granted to any operator who is currently found to be in violation of the provisions of this article with respect to any operation in this state.

34-32-121. Entry upon lands for inspection. The board, the bureau of mines of the state of Colorado, the chief inspector of coal mines, or their authorized representatives may enter upon the lands of the operator at all reasonable times for the purpose of inspection to determine whether the provisions of this article have been complied with.

34-32-122. Fees and forfeitures - deposit. All fees and forfeitures collected under the provisions of this article shall be deposited in the general fund.

34-32-123. Operating without a permit - penalty. (1) Whenever an operator or prospector fails to obtain a valid permit or file a notice of intent under the provisions of this article, the board may issue an immediate cease and desist order. Concurrently with the issuance of such an order, the board may seek a restraining order or injunction pursuant to section 34-32-124 (3).

(2) Any operator who operates without a permit or a prospector who prospects without filing a notice of intent shall be subject to a civil penalty of not less than one hundred dollars per day nor more than one thousand dollars per day during which such violation occurs; except that any operator eligible for a permit under section 34-32-110 shall be subject to a civil penalty of not less than fifty dollars nor more than two hundred dollars per day during which such violation occurs.

34-32-124. Failure to comply with the conditions of an order, permit, or regulation. (1) Whenever the board has reason to believe that there has occurred a violation of an order, permit, notice of intent, or regulation issued under the authority of this article, written notice shall be given to the operator or prospector of the alleged violation. Such notice shall be served personally or by certified mail, return receipt requested, upon the alleged violator or his agent for service of process. The notice shall state the provision alleged to be violated and the facts alleged to constitute the violation and may include the nature of any corrective action proposed to be required.

(2) If the board determines that there exists any violation of any provisions of this article or of any notice, permit, or regulation issued or promulgated under authority of this article, the board may issue a cease and desist order. Such order shall set forth the provisions alleged to be violated, the facts alleged to constitute the violation, and the time by which the acts or practices complained of must be terminated and may include the nature of any corrective action proposed to be required. Such order shall be served personally or by certified mail, return receipt requested, upon the alleged violator or his agent for service of process.

(3) In the event any operator fails to comply with a cease and desist order, the board may request the attorney general to bring suit for a temporary restraining order, a preliminary injunction, or a permanent injunction to prevent any further or continued violation of such order. Suits under this section shall be brought in the district court where the alleged violation occurs. If the board determines that the situation is an emergency, the emergency shall be given precedence over all other matters pending in such court.

(4) The board may require the alleged violator to appear before the board no sooner than twenty days after the issuance of such cease and desist order; except that an earlier date for hearing may be requested by the alleged violator.

(5) If a hearing is held pursuant to the provisions of this section, it shall be open to the public and conducted in accordance with the provisions of the "State Administrative Procedure Act", article 4 of title 24, C.R.S. 1973. The board shall permit all parties to respond to the notice served, to present evidence and arguments on all issues, and to conduct cross-examination required for a full disclosure of the facts.

(6) (a) Upon a determination, after hearing, that a violation of a permit provision has occurred, the board may suspend, modify, or revoke the pertinent permit.

(b) If the board suspends or revokes the permit of an operator, the operator may continue mining operations only for the purpose of bringing the mining operation into satisfactory compliance with the provisions of the operator's permit. Once such operations are completed to the satisfaction of the board, the board shall reinstate the permit of the operator.

(7) Any person who violates any provision of any permit issued under this article shall be subject to a civil penalty of not less than one hundred dollars per day nor more than one thousand dollars per day for each day during which such violation occurs; except that any operator who operates under a permit issued under section 34-32-110 shall be subject to a civil penalty of not less than fifty dollars nor more than two hundred

issued under section 34-32-110 shall be subject to a civil penalty of not less than fifty dollars nor more than two hundred dollars per day for each day during which such violation occurs.

SECTION 2. Article 22 of title 34, Colorado Revised Statutes 1973, is amended BY THE ADDITION OF A NEW SECTION to read:

34-22-105. Conflict with "Colorado Mined Land Reclamation Act". Nothing in this article shall apply to any mining operation regarding reclamation of mined land which is regulated by the mined land reclamation board pursuant to article 32 of this title.

SECTION 3. Article 40 of title 34, Colorado Revised Statutes 1973, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

34-40-121. Conflict with "Colorado Mined Land Reclamation Act". Nothing in this article shall apply to any mining operation regarding reclamation of mined land which is regulated by the mined land reclamation board pursuant to article 32 of this title.

SECTION 4. Effective date. This act shall take effect July 1, 1976.

SECTION 5. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

Ruben A. Valdez SPEAKER OF THE HOUSE OF REPRESENTATIVES	Fred E. Anderson PRESIDENT OF THE SENATE
Evelyn T. Davidson CHIEF CLERK OF THE HOUSE OF REPRESENTATIVES	Marjorie L. Rutenbeck SECRETARY OF THE SENATE

APPROVED ______________________________

Richard D. Lamm
GOVERNOR OF THE STATE OF COLORADO

federal register

MONDAY, MAY 17, 1976

THE NATIONAL ARCHIVES OF THE UNITED STATES
1934

PART II:

DEPARTMENT OF THE INTERIOR

Bureau of Land Management
Geological Survey

■

Coal Mining Operating Regulations

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

Geological Survey

COAL MINING OPERATING REGULATIONS

On September 5, 1975, there was published in the FEDERAL REGISTER (40 FR 41122 et seq.) a Notice of Proposed Rulemaking setting forth proposed revisions o 30 CFR Part 211 and 43 CFR 23, and o promulgate a new Part 3041 of 43 CFR. It was also proposed that 30 CFR Part 216, applicable to coal mining operations under leases in the State of Alaska which were issued pursuant to the Alaska Coal Leasing Act of October 20, 1914 (38 Stat. 741), prior to its repeal by Pub. L. 86–252, September 9, 1959 (73 Stat. 490), be revoked and that operations under those leases also be governed by the regulations set forth as proposed amendments to 30 CFR Part 211.

On December 18, 19 and 20, 1975, public meetings on the proposed rulemaking were held in Cheyenne, Wyoming, Denver, Colorado, and Billings, Montana, respectively. On February 13, 1976, the Director of the Bureau of Land Management and the Director of the United States Geological Survey submitted to the Secretary of the Interior proposed Final Rulemaking on the subject matter in question. A Final Environmental Impact Statement pursuant to the provisions of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321–47) was prepared on those recommendations, transmitted to the President's Council on Environmental Quality on March 5, 1976, and made available to the public on March 10, 1976.

As noted in the Notice of Proposed Rulemaking published on September 5, 1976, previous notices and texts of proposed rulemaking on the same subject matter had been published for public comment as proposed amendments to 30 CFR Part 211 on January 30, 1975, and on April 30, 1973 (38 FR 10686; 40 CFR 4428, respectively).

Extensive comments from other Federal agencies, State governments and representatives thereof, public interest groups, industry representatives and associations, and members of the general public have been received and carefully reviewed and considered by the Department of the Interior in connection with the proposed rulemaking.

Following such review, it has been decided to publish Final Rulemaking to amend 43 CFR 23, promulgate 43 CFR 3041, amend 30 CFR 211, and revoke 30 CFR 216, all as set forth below.

This Final Rulemaking is based upon the proposed rulemaking published on September 5, 1975, and the public comments received thereon, and upon the recommendations of the Directors of the BLM and the USGS to the Secretary of the Interior which were the subject of and were printed in the Final Environmental Impact Statement referred to above. The specific provisions have been addressed and discussed in the referenced Notice of Proposed Rulemaking and in the final Environmental Impact Statement, and need not be discussed in detail again herein.

Two changes from the regulations as they were printed in the Environmental Impact Statement should, however, specifically be noted. First, the provisions by which the Secretary would by formal rulemaking adopt the requirements of State laws and regulations relating to the reclamation of lands disturbed by the surface mining of coal where such requirements are determined to afford general protection of environmental quality and values at least as stringent as would occur under exclusive application of Federal regulations has been modified somewhat from the text published on September 5, 1975.

The decision to adopt the requirements of laws more stringent than Federal regulations is now made subject to the qualification that such adoption will occur unless the Secretary determines that specific provisions relating to overriding national interest require otherwise. Review of State laws for the purpose of making such determinations will be directed upon the effective date hereof, without prior application by a Governor, in those States where Federal coal is being developed. Finally, specific provision is made for the entry into discussions with representatives of such States for the purpose of entering into agreements, by formal rulemaking, to provide for the joint enforcement and administration of coal surface mine control programs within a State, provided Federal interests are protected. The Final Rulemaking is consistent with, and responsive to, the recommendations of numerous representatives of State goverments.

Second, the Final Rulemaking does not include the use of the phrase “maximum extent practicable.” Instead, the flexibility inherent in the use of this concept as previously proposed is obtained by redrafting some of the specific performance standards contained in the Final Rulemaking, and by the inclusion of provisions for the granting of variances from specific performance standards under certain conditions. (43 CFR Section 3041.8; 30 CFR Section 211.74). This alternative mechanism of achieving the necessary flexibility in the Final Rulemaking was suggested by many commentators on the proposed rulemaking, and is specifically addressed in the final Environmental Impact Statement referred to above, in Chapters VIII and IX and in Appendix 3.

In addition to the decisions made with respect to the Final Rulemaking published below, the Department has made several related decisions in connection with its ongoing review of Federal coal leasing and development. First, it has been decided to formulate and adopt specific criteria by which Departmental officers will be guided in deciding whether or not to withhold public lands from leasing based upon the fact that such lands may be unsuitable for mining. A Departmental task force is currently reviewing this question, and will shortly be presenting its recommendations to the Secretary for appropriate action.

It has also been decided that in view of the great interest and concern expressed by many commentators on the proposed rulemaking, and the presence of some Federally owned coal under land surface configurations that involve what are commonly referred to as "steep slopes," specific standards relating to mining on such terrain should be adopted. Since such standards were not contained in earlier proposed rulemaking published on September 5, 1975, and were not specifically addressed in the Final Environmental Impact Statement, it has been determined that they may not now be published in final form. Accordingly, there have been prepared and will shortly be published as proposed rulemaking amendments to the performance standards set forth in the Final Rulemaking published herein, and to the provisions authorizing the granting of variances therefrom, relating to mining on steep slopes.

Finally, as set forth below, the effective date of this Final Rulemaking is May 17, 1976. The specific operative provisions (43 CFR § 3041.0–5(b); 30 CFR Section 211.1(d)) set forth compliance requirements applicable to existing operations, involving compliance with the performance standards set forth (six months from the effective date) and with the balance of the regulatory requirements (18 months from the effective date.) Authority to take action in emergency circumstances will come into effect immediately on the effective date.

A new subpart 3041 is added to Part 3040 of 43 CFR, to read as follows:

Title 43—Public Lands: Interior

CHAPTER II—BUREAU OF LAND MANAGEMENT, DEPARTMENT OF THE INTERIOR

PART 3040—ENVIRONMENT AND SAFETY

Subpart 3041—Surface Management

FEDERAL COAL RESOURCES

Sec.
3041.0–1 Purpose.
3041.0–3 Authorities.
3041.0–4 Responsibilities.
3041.0–5 Applicability of regulations.
3041.0–6 Definitions.
3041.0–7 Use of surface.
3041.1 Coal leasing, permitting, and licensing planning procedures.
3041.1–1 Applications.
3041.1–2 Preliminary data.
3041.2 Technical examination/environmetal analysis.
3041.2–1 Technical examination/environmental analysis report.
3041.2–2 Obligations and standards of performance.
3041.3 Compliance or performance bond.
3041.4 Procedures and public participation.
3041.5 Completion of operations and abandonment.
3041.6 Reports.
3041.7 Notice of noncompliance: Revocation.
3041.8 Variances.

§ 3041.0–1 Purpose.

(a) The purpose of this subpart is to establish rules and regulations to be followed in the management of the federally owned coal estate consistent with the policies, goals, and objectives established by the Acts cited in § 3041.0–3 of this Subpart, regardless of surface ownership, to ensure effective and reasonable regulation of surface coal mining operations in accordance with the requirements hereof, as an appropriate and necessary means to minimize so far as practicable the adverse social, economic and environmental effects of such operations.

(b) It is the policy of the Department to encourage the development of Federally owned coal, where such development is authorized, through a program that will provide for the protection, orderly development and conservation of Federal mineral and nonmineral resources in a manner that will avoid, minimize or correct adverse impacts on society and the environment resulting from coal development, without undue duplication or administrative delay by Federal officers. It is also the policy of the Department to issue leases, permits, and licenses for coal only where reclamation of the affected lands to the standards set forth herein is attainable and assured and a reclamation program will be undertaken as contemporaneously as practicable with operations. Departmental policy regarding privately owned surface where the mineral estate is Federally owned is that any mineral activity on the private surface should be conducted to result in protection of environmental values which is at least as stringent as would apply to Federally owned surface.

§ 3041.0–3 Authorities.

The regulations contained in this Subpart are issued pursuant to the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181–287), and the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351–359), and in accordance with the policies set forth in the National Environmental Policy Act of 1969, as amended, (42 U.S.C. 4321–47). Additional regulations governing the issuance of Federal coal leases, permits, and licenses are found in 43 CFR 3500 of this Chapter, including the specific requirement in § 3501.2–6 that the consent of the Department of Agriculture or other Federal surface managing agency be obtained with respect to leases, permits, and licenses covering acquired lands subject to the jurisdiction of such agency. Regulations governing operations conducted on lands subject to lease, permit, or license are found in 30 CFR 211. Regulations setting forth the general and basic policies for disposal and management of the public lands are found in 43 CFR 1725 of the Chapter.

§ 3041.0–4 Responsibilities.

(a) The Bureau of Land Management (BLM) exercises at the Bureau level the Secretary's discretionary authority to determine whether or not mineral leases, permits, and licenses are to be issued. The BLM is responsible for issuing coal leases, permits, and licenses, and is the office of record in mineral leasing matters.

(b) The Geological Survey (GS) exercises the Secretary's authority regarding operations conducted within the area of operations by permittees, lessees, and licensees and determines the action to be taken by them from the standpoint of the development, conservation, and management of mineral resources under the jurisdiction of the Department. The Geological Survey is responsible for all geologic, engineering, and economic value determinations for the Department's mineral leasing program. These determinations include: the mineral characteristics of lease and permit areas; parceling; appropriate amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investments, diligent development, and minimum production requirements; and all other terms and conditions relating to mineral operations under leases and permits.

(c) The BLM or other Federal surface managing agency, in consultation with the GS and the surface owner if other than the United States, formulates the requirements to be incorporated in leases, permits, and licenses for the protection of the surface and nonmineral resources and for reclamation, using the reclamation obligations and standards of performance contained in § 3041.2–2 of these regulations and in 30 CFR 211.40.

(d) The GS reviews and approves exploration and mining plans, and authorizes the abandonment of operations, in consultation with the BLM or other appropriate Federal surface managing agency, and the surface owner, if other than the United States, on the adequacy of the surface use, environmental protection, and reclamation aspects of such plans and will not grant approval if inconsistent with the BLM's or other Federal surface managing agency's recommendations without further discussions and referrals for resolution pursuant to 30 CFR 211.

(e) As to the lands outside of the area of operations, the authorized officer of the BLM or other appropriate Federal surface managing agency is responsible for conducting compliance examinations and for assuring compliance by the lessee, permittee, or licensee with the requirements of this Subpart, and the terms and conditions of a lease, permit, or license and for reporting noncompliance to the Mining Supervisor for appropriate action. As to the lands inside the area of operations the GS examines operations to ensure compliance by the lessee, permittee, or licensee with the terms and conditions set forth in the provisions of any lease, permit or license or any approved mining or exploration plan. GS refers to BLM any instance of noncompliance with lease terms which may require cancellation action, and BLM may initiate such
action. With respect to approval o
cess roads, pipelines, utility routes
other surface uses outside the ar
operations, the BLM, or other Fe
surface managing agency, has the
mary responsibility but obtains the
ommendations of the GS before t
final actions. Except as may be expr
provided for in § 3041.7 of this Sub
and 30 CFR 211.72, orders to oper
for any remedial action are the excl
responsibility of the Geological Surve

(f) Subject to the supervisory aut
ity of the Secretary, the regulatio
this subpart shall be administered b
Director, Bureau of Land Manage
through the authorized officers ha
jurisdiction over the lands subjec
these regulations and authorized to
form the duties described. Prior to
ance of any coal lease, permit, or lic
the authorized officer shall consult
and accept and consider recomme
tions from the Mining Supervisor,
Federal surface managing agency
other than the BLM, or the su
owner, as to the terms and condition
quired to achieve the purpose of this
part. Any disagreements that cann
resolved between the GS and the
arising in connection with any suc
suance of a lease, permit or license
be referred for resolution to the ap
priate Assistant Secretaries or to
Under Secretary of the Departme
the Interior. Any such disagreement
tween an authorized officer of the
and an appropriate authorized offic
any Federal surface managing ag
not in the Department of the Int
will be referred for resolution to co
rable higher authorities in each age
and, if necessary, to the respective
partments, for final resolution.

§ 3041.0–5 Applicability.

(a) This Subpart sets forth reg
tions governing leasing, permitting,
licensing procedures, reclamation st
ards, use of surface, bond requirem
and reports relating to leases, per
and licenses issued by the BLM with
spect to Federal coal deposits locate
public domain and acquired lands o
United States and reserved Federal
deposits underlying lands the surfa
which is privately owned. These reg
tions do not govern the leasing
development of coal deposits owne
Indians and subject to the Trust pr
tion of the United States, which are
trolled by regulations found in 25
Chapter I.

(b) The provisions of this sub
shall become effective upon the da
publication in the FEDERAL REGISTE
final rulemaking, except as herein
provided.

(1) Existing operations. (i) On
after 180 days from the effective
of this subpart, the provisions of §30
2(f) shall apply to all existing opera
with respect to lands from which
overburden has not previously been
moved, provided, however, that
paragraph shall not be deemed or

strued so as to apply the requirements of § 3041.2–2(f) (1) and (2), hereof to any operation for which a mining plan has been approved on or before the effective date of this subpart and for which a variance pursuant to the provisions of § 3041.2–2(f) (2) would be required.

(ii) On or before 18 months from the effective date of this Subpart, the operator of each existing operation shall have submitted and shall have obtained the approval of a plan or modification thereof of which shall comply with all applicable provisions of this Subpart, provided, however, that if the Director of the GS determines that a proposed new plan or modification of an existing plan was prepared and submitted in timely fashion, taking into account the complexity of the operation and of the plan or modification involved, but that administrative delay thereafter has prevented approval within the time specified, the time for compliance with this paragraph may be extended by order of the Director of the GS for an amount of time equal to the duration of such delay.

(iii) For the purpose of this paragraph, the term "existing operation" shall mean:

(A) All operations for which a plan has been approved on or before the effective date of this subpart, and

(B) All operations with respect to which a proposed plan has been submitted to the Department on or before the effective date of this Subpart, and with respect to which proposed plan the Department has on that date either completed its environmental impact analysis and determined that no environmental impact statement under Section 102 (2)(C) of the National Environmental Policy Act is necessary, or has determined that such a statement is necessary and has commenced, and expended substantial resources of the Department in the preparation or completion of, such a statement.

(iv) On or before 90 days from the effective date of this subpart, the Director of the Geological Survey shall review all proposed plans which have been submitted to the Department on or before the effective date of this subpart and, after consultation with appropriate Federal surface managing agencies, publish in the Federal Register a list which shall identify each such proposed plan and whether it will be considered to cover an existing operation.

(2) All operations or proposed operations not included in the definition of "existing operation" in the preceding paragraph shall be considered to be new operations, and shall be subject to the provisions of this subpart upon the effective date hereof.

(3) The provisions of § 3041.7(c) of this subpart shall apply immediately upon the effective date of this subpart.

(c) To the maximum extent possible, all environmental impact statements and all approvals of plans covering existing operations which are pending before the Department on the effective date of this subpart shall take into account and shall reflect and implement the provisions and purposes hereof; provided, however, that nothing in this subparagraph shall be construed to relieve any operator of the obligation imposed by paragraph (b)(1)(i) above.

(d) Nothing in this subpart shall be deemed or construed as increasing or diminishing any rights not in conflict with Federal law held by any person, including any surface owner or entryman, arising under the laws of any State and relating to the giving or withholding of consent to, or consultation in connection with, entry to any land for the purpose of conducting operations subject to this subpart.

§ 3041.0–6 Definitions.

As used in this subpart, the following terms shall have the following meanings:

(a) "Acid or toxic producing materials" means natural or disturbed earth materials having chemical and physical characteristics that, under mining or postmining conditions of drainage, exposure, or other processes, may produce effluents that contain chemical constituents, such as acids, bases, or metallic compounds, in sufficient concentrations to individually or in combination adversely affect the environment.

(b) "Affected lands" means any lands affected or to be affected by exploration, development, and mining operations and the construction of facilities necessary and related to such operations.

(c) "Approximate original contour" means the surface configuration achieved by backfilling and grading of the mined area so that it closely resembles the surface configuration of the land prior to mining (although not necessarily the original elevation) and blends into and complements the drainage pattern and topography of the surrounding terrain.

(d) "Area of operations" means that area of the leased, permitted, or licensed lands which is required for exploration, development, producing, and processing operations, including all related surface structures and facilities, and which is delineated on a map or plat that is made a part of the approved exploration or mining plan.

(e) "Authorized officer" means any officer designated by any Federal surface managing agency to exercise its authority in matters relating to coal leases, licenses, and permits and to the provisions of this subpart.

(f) "Coal" includes coal of all ranks from lignite to anthracite.

(g) "Compaction" means the reduction of porous spaces among the particles of soil and rock generally caused by running heavy equipment over the earth materials, as in the process of leveling the overburden material on strip mine spoil piles or banks, for the purpose of increasing the bearing capacity and stability of the earth materials.

(h) "Contemporaneously as practicable" means with respect to reclamation of mined or otherwise disturbed areas, the commencement, conduct and completion of reclamation activity as soon after disturbance as possible, without undue physical interference with ongoing opreations, leaving a minimum of land unreclaimed, consistent with the objectives of environmental protection set forth in this subpart.

(i) "Daylighting" is a term used to define the surface mining procedure for exposing an underground mined area to remove remaining coal.

(j) "Director" means the Director of the Bureau of Land Management, U.S. Department of the Interior.

(k) "Exploration" means the detailed investigation and acquisition of data pertaining to a mineral deposit, including activities for identifying regions or specific areas in which deposits are most likely to occur, and activities used to establish the nature of a coal deposit preparatory to mining.

(l) "Exploration plan" means a detailed plan submitted to the Mining Supervisor for approval before exploration operations commence showing the location and type of exploration work to be conducted, environmental protection procedures, roads, and reclamation procedures to be followed upon completion of such appropriations.

(m) "General Coal Mining Order" means a formal numbered order issued by the Mining Supervisor, with the prior approval of the Division Chief, and published, after opportunity for public comment, in the Federal Register, which implements the regulations in this Part and applies to coal mining and related operations in a specified geographic area.

(n) "Impoundment" means an artificially built, dammed, or excavated place for the retention of water or sediments. A permanent impoundment is one that is intended to remain after final abandonment of the operation, and shall be identified as such in an approved plan.

(o) "Leased lands, leased premises, or leased tract" means lands embraced within a coal lease and subject to the regulations in this subpart.

(p) "Lessee" means any person or persons, partnership, association, corporation, or municipality to whom a coal lease is issued, subject to the regulations in this subpart, or an assignee of such lease under an approved assignment.

(q) "Licensee" means any individual, association of individuals, or municipality to whom a coal license is issued pursuant to the provisions of section 20 of Title 30 of the United States Code.

(r) "Logical mining unit" means an area of land designated as such by the Geological Survey pursuant to applicable Departmental regulations.

(s) "Method of operation" means the method and manner by which any activities are performed by the operator, as described in an exploration or mining plan.

(t) "Mine" means an underground or surface excavation and the surface or underground support facilities that contribute directly or indirectly to coal mining, preparation, and handling.

(u) "Mining plan" means a detailed plan for development of the coal resource submitted to the Mining Supervisor for approval prior to commencement of any mining operation, showing the proposed location, method, and extent of mining and all related activities necessary and incidental to such operation, including steps to be taken to reclaim disturbed areas, to mitigate adverse impacts, and to otherwise meet the performance standards and requirements set forth in this Subpart.

(v) "Mining Supervisor" means the Area Mining Supervisor, Conservation Division, Geological Survey, or District Mining Supervisor or other subordinate acting under his direction.

(w) "Notice of Availability" means a formal notification, by the appropriate Federal officer, to appropriate Federal, state and local agencies and interested individuals or groups of individuals, of the availability for inspection of information, data, proposed plans or modifications thereof, pending decisions and other documents subject to such notice. Any such notice shall include the nature of the information, data, plan or modification, decision or other document involved; the name and mailing address of any applicant; the nature, location (county, township, range and section), duration and brief description of any proposed operations; the date upon which any proposed action might be taken; and, when appropriate, a specific time limit for public review, comment or request for any departmental action, including the holding of any public meeting. For the purpose of ensuring appropriate distribution of such notices, there shall be maintained at each office of a Mining Supervisor or authorized officer of the Department of the Interior a mailing list which shall consist of the names and mailing addresses of all appropriate Federal, state or local agencies and any individuals or groups of individuals who have requested in writing to be included on such lists. All notices of availability shall be mailed to such agencies, individuals or groups at the addresses indicated on such lists.

(x) "Notice of noncompliance" means a written notice of operator noncompliance issued pursuant to § 211.72 of 30 CFR Part 211.

(y) "Operator" means a lessee, permittee, or licensee, or one conducting operations on lands under the authority of the lessee, permittee, or licensee.

(z) "Overburden" means the earth, soil, rock, and other natural materials which lie above the coal being mined.

(aa) "Permanent abandonment" means the cessation of exploration or mining or other operations set forth in an approved plan on all or any portion of lands covered by a lease, permit or license and subject to the provisions of this Subpart, where it is the intent of the operator not to continue operations at the mine or portion thereof.

(bb) "Permit lands" means lands embraced within a coal prospecting or other permit and subject to the regulations in this subpart.

(cc) "Permittee" means any person or persons, partnership, association, corporation, or municipality to whom a coal prospecting or other permit subject to the regulations in this subpart is issued, or an approved assignee of such permit.

(dd) "Pollution" means man-made or man-induced adverse alteration of the chemical, physical, biological, and radiological integrity of land, water or air, which reduces, or has the potential of reducing the beneficial uses of these resources.

(ee) "Post mining land use" means that use which will be made of affected lands after mining and reclamation is completed and which is specified in a mining or exploration plan approved pursuant to 30 CFR 211.

(ff) "Preliminary data" means data, consisting of maps and text, submitted by an applicant for a lease, permit, or license to the authorized officer of the BLM, which describes the applicant's proposal in the detail necessary to allow the authorized officer to conduct a technical examination and environmental analysis as described in § 3041.2.

(gg) "Preparation" means any crushing, sizing, cleaning, drying, mixing or other processing of coal to prepare it for market which is conducted on lands subject to this subpart.

(hh) "Reclamation" means the process of returning affected lands to a stable condition and form consistent with their premining productivity and use, or other approved post mining land use.

(ii) "Road" means any open way for passage or travel upon which to transport people, equipment, materials, or coal, which is constructed, improved or maintained by the operator and which is used to service the pit, bench, underground mine workings, loading facilities or exploration activities.

(jj) "Secretary" means the Secretary of the Interior.

(kk) "Significant vegetation" means farm crops, including grasses and forbs, that are integral parts of agriculture or ranching operations and the natural vegetation of forests or meadows with significant recreational, watershed, agricultural, or wildlife habitat value.

(ll) "Spoil" means soil, rock, and other earth materials that are broken, moved, dumped, or otherwise significantly disturbed during surface coal mining operations subject to this subpart.

(mm) "Subsidence" means a lowering of surface elevations over an underground mine caused by loss of support and subsequent caving of strata lying above the mine.

(nn) "Surface owner" means an entryman, or a person or persons who hold legal title to the land surface.

(oo) "Topsoil" means natural earth materials at or vertically adjacent to the land surface with physical and chemical characteristics suitable for support of vegetation.

(pp) "Valley floors" means the channelways, floodplains, and adjacent low terraces of streams that are flooded during periods of high flow and that are underlain by unconsolidated stream-laid deposits. Excluded are higher terraces and slopes underlain by colluvial and other surficial deposits normally occ
ring along valley margins.

(qq) "Waste" means solid or liquid
use, rubbish, or other valueless mate
which is produced by or in connect
with coal mining operations, includ
exploration, production, developm
preparation and other related activit
and which has no useful purpose in c
nection with any remaining operation

§ 3041.0–7 Use of surface.

(a) The operator shall be entitled
use only so much of the surface of
lands subject to a lease, permit, or
cense as is deemed necessary and
been designated in an approved pl
This subpart shall not be construed
authorize any use of the Federal la
for a power generation plant or a co
mercial or industrial facility. Separ
permits for such uses must be obtai
from the appropriate agency. The
erator shall not be entitled to use
mineral materials subject to the Ma
rials Act except as provided by Part 3
of this Chapter.

(b) Operations conducted in conn
tion with other authorized uses on
same lands shall not unreasonably
terfere with or endanger operations c
ducted in connection with uses auth
ized under this Chapter, nor shall op
ations authorized and conducted pur
ant to this Chapter unreasonably int
fere with or endanger operations un
any lease, permit, license, or other
authorized pursuant to the provisi
of any other Act.

§ 3041.1 Coal leasing, permitting, a licensing planning procedures.

(a) When an area is initially cons
ered for coal development the app
priate authorized officer shall make
environmental analysis of the potent
effect of such development upon the
sources of the area and its environme
pursuant to Section 3041.2 hereof.

(b) Prior to the selection of tracts
coal leases, permits, or licenses the a
propriate authorized officer shall eval
ate the potential effects of all phases
such coal development on the enviro
ment, including effects on fish and oth
aquatic resources, wildlife habitats a
populations, and visual, recreational, c
tural, and other resources in the
fected area. This evaluation shall ta
into account alternative uses of the la
and its natural resources, the need
the proposed coal development, and t
socio-economic considerations releva
to multiple-use management principl
To aid him in this evaluation and in t
selection of coal lease, permit, or licen
tracts, such authorized officer shall iss
a call for information and nominatio
for tracts to be leased competitively a
for areas which should not be lease
as set forth in Subpart 3520 of this Cha
ter, and shall request and consider t
views and recommendations of the Ge
logical Survey and other appropria
Federal agencies; may hold public hea
ings after appropriate notice, and sh
consult with applicants, nominato
State and appropriate local agencies, o

ations, industries, and surface
rs if other than the United States.

If the Director determines that
cision to consider areas for coal
opment or to select tracts to offer
eases, permits, or licenses would be
jor Federal action significantly af-
ng the quality of the human envi-
ent, and that an environmental
ct statement as required by the Na-
l Environmental Policy Act of 1969
U.S.C. 4321 et seq.) has not been
ared with respect thereto, such a
ment will be prepared.

If National Register or eligible
nal Register cultural resources
t be affected by the issuance of coal
s, permits or licenses, none will be
orized until compliance with Sec-
106 of the Historic Preservation Act
Stat. 917; 16 U.S.C. § 470f) and sec-
2(b) of E.O. 11593 of May 13, 1971
FR 8921; 16 U.S.C. § 470 fn.) has
accomplished.

If a decision is made to offer tracts
oal leases, permits, or licenses, the
opriate authorized officer may, fol-
ng the procedures in § 3041.2 of this
pter, develop and include in such
such special terms and conditions
nay be required by specific local
itions to protect the environment,
rmit use of the land for other pur-
s, to allow post mining land uses,
to protect other resources. The au-
ized officer, in consultation with the
ng Supervisor, the appropriate au-
ized officer of any surface managing
cy other than BLM and the surface
er if other than the United States,
l include in the terms and conditions
ny permit, lease or license such spe-
requirements as may be necessary
eet exceptional and special circum-
ces relating to the lands covered
eby, including degree of slope, soil
litions, and other site characteristics.

) Geological and geophysical data
information, including maps, that
be used to calculate coal reserves in
e, and trade secrets and commercial
financial information obtained from
person under this subpart which is
tified as privileged or confidential
l not be available for public inspec-
or made public or disclosed without
consent of the permittee, licensee,
e or operator, provided however that
n termination of a permit, lease or
nse, whether by expiration of its
ns or otherwise, or final abandon-
t of operations, resource and reserve
and information that may be used
alculate coal reserves in place sub-
ed and so identified as privileged or
fidential may be made available for
lic inspection or made public or dis-
ed. As used in this section, "resource
reserve data and information"
ns geological and geophysical data
information, including maps, relat-
to the coal deposits within the per-
or leased lands or covered by an
roved plan which is abandoned. Re-
sts for inspection of resource and re-
e data and information shall be made
ccordance with the regulations set
h in 43 CFR Part 2, which implement the Freedom of Information Act, as amended (5 U.S.C. 552).

§ 3041.1–1 Applications.

(a) Any person who desires a lease, permit or license for coal development to be issued on his own motion shall file an application in the proper BLM office, in accordance with the regulations in this Chapter.

§ 3041.1–2 Preliminary data.

(a) Any application for coal lease, permit, or license filed pursuant to the regulations in this Chapter shall contain preliminary data to assist the authorized officer in making a technical evaluation and environmental analysis as described in § 3041.2. Provided, however, that in lieu of the requirements of this paragraph, applicants for competitive coal leases offered pursuant to the BLM Energy Minerals Activity Recommendation System (EMARS) will be required to fulfill the requirements of Subpart 3521 of this Chapter.

(b) Such preliminary data shall include: (1) Such map, or maps, as may be available from State or Federal sources, on which shall be shown the topography of the land applied for, and on which the applicant shall show physical features and natural drainage patterns and existing roads, vehicular trails, and utility systems; the location of any proposed exploration operations, including seismic lines, drill holes, to the extent known, the location of any proposed mining operations and facilities, trenches, access roads or trails, and support facilities incidental thereto, including the approximate location and aerial extent of the areas to be used for pits, overburden, and tailings; and the location of water sources or other resources which may be used in the proposed operations or facilities incidental thereto.

(2) A narrative statement, including: (i) The anticipated scope, method, and schedule of exploration operations, including the types of exploration equipment to be used.

(ii) The method of mining anticipated, including the best available estimate of the mining sequence and production rate to be followed.

(iii) The relationship, if any, between the mining operations anticipated on the lands applied for and existing or planned mining operations, or facilities incidental thereto, on adjacent Federal or non-Federal lands.

(iv) A brief description, including suitable maps or aerial photographs as appropriate, of the existing land use within and adjacent to the lands applied for; and of known geologic, visual, cultural, or archaeological features; and the known habitat of fish and wildlife, particularly threatened and endangered species, that may be affected by the proposed or reasonably anticipated exploration or mining operations.

(v) A brief description of the proposed measures to be taken to maximize, control, or prevent fire, soil erosion, pollution of surface and ground water, damage to fish and wildlife or other natural resources, air and noise pollution, and hazards to public health and safety; to reclaim the surface; and to otherwise meet applicable laws and regulations, which the applicant wishes to have considered by the authorized officer.

(c) The applicant shall not enter upon the land for any operational purpose, except for casual use, without prior authorization. Casual use, as used in this section, means activities which do not cause significant surface disturbance or damage to lands, resources, and improvements, such as activities which do not include (1) the use of heavy equipment or explosives, or (2) vehicular movement off established roads and trails which causes such disturbance.

(d) The authorized officer, after reviewing the preliminary data contained in an application, and at any time during a technical examination and environmental analysis, may request additional information from the applicant.

§ 3041.2 Technical examination/environmental analysis.

In connection with an application for a coal lease, permit or license, or on BLM motion, the appropriate authorized officer, with the assistance of the Mining Supervisor, shall make a technical examination and environmental analysis of the area covered by such application, pursuant to the provisions of this section.

(a) The technical examination shall include: (1) An examination of the technical aspects of the proposed operations set forth in any preliminary data and information; and

(2) An evaluation of the impacts of such operations or, if on BLM motion, the effect of coal leasing and development, on other land uses, resources, or land management programs on or adjacent to the area.

(b) The environmental analysis shall include an analysis of the impact of the proposed operations set forth in any preliminary data and information and of alternatives thereto, or, if on BLM motion, the impacts of coal leasing and development on the living and nonliving components of the environment.

§ 3041.2–1 Technical examination/environmental analysis report.

(a) Following completion of the technical examination and environmental analysis described in the preceding Section, the authorized officer shall prepare a report which sets forth recommendations as to (1) land which should be excluded from any lease, permit, or license in order to avoid mining where reclamation is not attainable or assured, or in recognition of other exclusive land use management priorities; (2) measures required to comply with the reclamation and performance standards set forth in this subpart; (3) necessary conditions and amounts of bonds to cover estimated reclamation costs for areas that will be disturbed during the initial 5 year period of the lease, permit, or license; (4) any additional, more stringent requirements needed in the lease, permit, or license pursuant to § 3041.1(e) of this subpart.

(b) If it is recommended that a specific area within the applied for lands be excluded from a lease, permit, or license, or modification thereof, the report shall set forth with reasonable specificity the facts upon which such recommendation is based.

§ 3041.2-2 Obligations and standards of performance.

(a) Any operator who accepts a coal lease, permit, or license shal lcomply with, and be bound by, the general obligations and standards of performance set forth in this section and such additional and more stringent specific requirements as may be contained in the terms and conditions of such lease, permit or license.

(b) If the appropriate authorized officer of the BLM determines that an approved exploration or mining plan should be required to be revised or supplemented to adjust to changed conditions or to correct oversights, he may propose such revision or supplement to the Mining Supervisor for action pursuant to the provisions of 30 CFR Part 211 relating to changes in plans.

(c) Surface coal mining operations shall be conducted so as to assure the extraction of the coal resource to the maximum extent possible, taking into account existing technology, commercially available equipment, the cost of production, and the quality and quantity of the coal resource, so that future environmental disturbance through the resumption of mining will be minimized.

(d) The operator shall, in accordance with the terms and conditions of the lease, permit, or license (1) take visual resources identified by the Federal surface managing agency into account in the planning, design, location, and construction of facilities on the affected lands; and (2) take such action as may be needed to minimize, control, or prevent damage to the recreational, cultural, scientific, historical and known or suspected archeological and paleontological values of the land contained therein.

(e) The following performance standards shall be applicable to the surface effects of underground mining.

(1) Each operator of an underground coal mine shall adopt, measures consistent with feasible known technology in order to prevent or, in those instances where the mining method used requires planned subsidence in a predictable and controlled manner, control subsidence; maximize mine stability; and maintain the value and use of surface lands.

(2) Where pillars or panels are not removed and controlled subsidence is not part of the mining plan, pillars or panels of adequate dimensions shall be left to assure stability giving due consideration of the thickness and strength characteristics of the coal beds and of the strata above and immediately below the coal bed.

(f) The following performance standards shall be applicable to all coal exploration, development, mining, preparation, handling, and reclamation operations on the surface of lands subject to this subpart:

(1) The operator shall reclaim affected lands pursuant to his approved plan, as contemporaneously as practicable with operations, to a condition capable of supporting all practicable uses which such lands were capable of supporting immediately prior to any exploration or mining, or equal or better uses that have been approved in accordance with this subpart.

(2) The operator shall replace overburden and waste materials in the mined area by backfilling (compacting, where necessary, to ensure stability or to prevent leaching of toxic materials), grading or other means, so as to cover all acid-forming or other toxic materials and eliminate highwalls and spoil piles and restore the approximate original contour. Where the thickness of the coal deposits relative to the volume of overburden is large and where the overburden and other spoil and waste materials are either insufficient or more than sufficient to restore the approximate original contour, the operator shall, in order to provide adequate drainage, backfill, grade, and where necessary, compact, using all available overburden or spoil material, to obtain the lowest practicable grade, which shall in any event be less than the angle of repose. Excess overburden or other spoil material shall be fully reclaimed in accordance with the requirements of this Subpart. Variance from the requirements of paragraphs (1) and (2) of this subsection may be allowed in an approved mining plan if the Director of the Geological Survey, with the concurrence of the Director of the Bureau of Land Management or the comparable appropriate authorized officer, determines that unusual physical conditions at the site, such as steeply dipping coal beds or multiple seam mining, exist, and such conditions make backfilling pursuant to such requirements impracticable as a result of the volume of material excavated or environmentally undesirable as a result of the duration of the operation.

(3) The operator shall stabilize and protect all surface areas, including spoil piles, affected by the coal mining and reclamation operation, to effectively control slides, erosion, subsidence, and attendant air and water pollution.

(4) The operator shall remove topsoil separately, for replacement on the backfill area, and if not so utilized immediately, segregate it in a separate pile from other spoil. When topsoil is not to be replaced on a backfill area within a time short enough to avoid deterioration, the operator shall establish and maintain an approved quick growing vegetative cover or employ other approved measures so that the topsoil is protected from wind and water erosion and establishment of noxious plan species, and is in a condition for sustaining vegetation when used during reclamation. If topsoil is of insufficient quantity or of poor quality for sustaining vegetation, and if other excavated materials can be shown to be more suitable for revegetation, then the operator may be authorized in the approved plan to remove, segregate, protect, and utilize in a like manner such other materials.

(5) The operator shall ensure that water impoundments, water retention facilities, dams, or settling ponds have been set forth in an approved plan, and ensure that:

(i) Any such facility is adequate for its intended purposes and the quality and quantity of impounded water will be suitable for its intended use.

(ii) Any such facility is designed, located, built, used, and maintained in accordance with sound engineering standards and practices and applicable Federal and State laws and regulations, to ensure that such facilities will have necessary stability with an adequate margin of safety.

(iii) Final grading will provide adequate safety and access for proposed or reasonably anticipated water users.

(iv) Such facilities will not have a significant adverse impact on the water resources utilized by adjacent or surrounding landowners for agricultural, industrial, recreational, or domestic uses, provided, however, that this paragraph shall not be deemed or construed to increase or diminish any property rights to any water held by any person.

(v) No mine or processing waste is used in the construction of such facilities unless authorized in the approved plan.

(6) The operator shall cover or plug all auger mine holes with noncombustible and, where necessary to minimize control or prevent harmful drainage, impervious material.

(7) The operator shall utilize the best practicable commercially available technology to minimize, control or prevent disturbances of the prevailing quality, quantity and flow of water in surface and ground water systems, and of the prevailing erosion and deposition conditions at the mine site and in affected offsite areas, both during and after coal mining operations and reclamation, by:

(i) Controlling acid or toxic drainage and the adverse consequences thereof by such measures as, but not limited to, diverting surface runoff water away from disturbed areas; excluding oxygen from, or restricting the flow of water through acid or toxic-producing minerals; treating drainage to reduce acid or toxic content which adversely affects downstream water upon being released to water courses; and casing, sealing, or otherwise treating drill holes, shafts, and wells to keep acid or toxic drainage from entering ground and surface waters.

(ii) Conducting surface mining operations so as to minimize, control, or prevent (A) contributions of suspended solids to streamflow or runoff outside the mining site above natural levels under seasonal flow conditions as measured for a period and at sites determined by the Mining Supervisor, in consultation with

appropriate authorized officer, and
except where specifically authorized
n approved plan, deepening or en-
ing of stream channels where opera-
s include the discharge of water from
es.

ii) Removing or modifying siltation
ctures after disturbed areas are re-
tated and stabilized unless otherwise
orized by the Mining Supervisor in
pproved plan, with the concurrence
he appropriate authorized officer,
ided, however, that any siltation
cture retaining water shall, in any
t, be subject to the requirements of
41.2–2(f)(5) of this subpart.

v) Protecting the quality, quantity
flow, including depth of flow, of up-
am and downstream surface and
und water resources of those valley
s which provide water sources that
ort significant vegetation or supply
ificant quantities of water for other
oses, by such measures as, but not
ted to, relocating and maintaining
gradients of stream, avoiding mining
alling, reestablishing or replacing
ifiers or aquicludes, and replacing
, provided, however, that this sub-
agraph shall not be deemed or con-
ed to increase or diminish any prop-
rights to any water held by any
on.

) The operator shall: (i) Treat or
ose of all rubbish and noxious sub-
ces in a manner designed to mini-
e, control or prevent air and water
ution and the hazards of ignition
combustion.

i) Dispose of all waste resulting from
mining and preparation of coal in a
ner designed to minimize, control or
vent air and water pollution and haz-
s of ignition and combustion. Where
ace disposal of solid wastes in areas
er than the mine workings or other
avations has been authorized in the
roved plan, stabilize such waste in-
ling, where necessary, constructing
te piles in compacted layers with the
of incombustible and impervious
terials; shape waste piles to be com-
ible with the natural surroundings
terrain; cover with topsoil or other
able material in accordance with
agraph (f)(4) of this section; and
egetate in accordance with paragraph
(13) of this Section. All impound-
nts of liquid wastes shall comply with
requirements of subparagraph (f)(5)
this Section. Waste containing coal in
h quantity that it may be later sepa-
ed from the waste by washing or other
ans shall be stored separately.

9) Except as provided herein, the op-
tor shall not conduct excavation, drill-
, or blasting operations within 200
t of an active or abandoned under-
und mine. Where it can be established
certified maps or inspection of such
underground mine that such activities
y be conducted without danger of in-
ference with, or penetration of, an
derground mine, they may be author-
d in an approved plan to be conducted
to but not less than 25 feet from such
derground mine provided that nothing
this paragraph shall preclude daylighting or similar surface coal mining activities intended to improve resource recovery, abate water pollution, or eliminate public hazards resulting from such underground mines.

(10) To prevent personal injury or damage to public and private property, the operator shall use explosives only in accordance with all applicable Federal and State laws and an approved plan and shall:

(i) Provide adequate advance written notice, by publication and/or posting of planned blasting schedules, to local governments and to residents who might be affected by the use of such explosives, and maintain a log of the magnitudes and times of blasts for a period of at least two years.

(ii) Limit the size, timing, and frequency of blasts, as determined by the physical conditions of the site.

(11) The operator shall design to applicable standards, construct, maintain and, when no longer necessary and unless otherwise authorized in an approved plan, remove, all roads, pipelines, powerlines and similar utility access facilities and associated bridges, culverts and ditches, into and across the site of operations, in a manner that will minimize, control or prevent erosion and siltation, fugitive dust, pollution of water, damage to fish or wildlife or their habitat and public or private property.

(12)(i) Roads shall not be surfaced with any acid or toxic producing material. No access roads will be constructed unless (A) the operator shall have first submitted a surveyed profile accompanied by typical cross-sections of the road and ditches, showing pipe, entrance, exit channels and sediment control structures and other structures or configurations to be used on the road to meet performance standards and (B) the location shall have been marked and inspected, and approved by the Mining Supervisor, in consultation with the appropriate authorized officer and the surface owner, if other than the United States.

(ii) No access road shall be constructed in a stream, nor shall any stream or stream bed be used as an access road. Insofar as possible, all roads shall be located on benches, ridges, and flatter slopes to enhance stability and minimize disturbance. Stream fordings shall be avoided and the normal seasonal flow and the normal seasonal sediment load shall not be detrimentally affected by access roads in a continuous fashion that results in harm to the aquatic ecosystem. Provided, however, that nothing in this subparagraph shall be construed to prohibit relocation or alteration of such beds or channels pursuant to the provisions of this subpart and as set forth in an approved plan.

(13)(i) The operator shall, except where other reclamation based upon post-mining land use and not requiring revegetation pursuant to the requirements of this section is expressly provided for in an approved plan, establish on regraded areas and all other affected lands a diverse vegetative cover, native to the area and capable of regeneration and plan succession at least equal in density and permanence to the natural vegetation provided, however, that the Mining Supervisor, with the concurrence of the appropriate authorized officer may allow the use of approved mixtures of introduced or native species where preferable to achieve quick cover or assure successful revegetation. In approving such mixture, preference will be given to non-toxious species.

(ii) The operator's responsibility and liability under his performance bond for revegetation of each planting area shall extend until such time as the appropriate authorized officer, in consultation with the Mining Supervisor and the surface owner, if other than the United States, determines that successful revegetation in compliance with paragraph (i) of this subsection has occurred, provided, however, that this period shall extend for a minimum of five full years after the first planting, and for a total period of liability not to exceed 10 years from the original planting; and further provided that,

(A) where the appropriate officer, in consultation with the Mining Supervisor, determines that natural conditions such as annual precipitation, soil characteristics and native vegetation are stable and favor rapid revegetation, and that revegetation pursuant to subparagraph (i) of this subsection is likely to occur before the expiration of such minimum period, he may specify in the lease, permit, or license that such minimum period will not apply with respect to some or all of the lands included in such lease, permit or license; and

(B) where during any such minimum period such authorized officer, in consultation with the Mining Supervisor and the surface owner, if other than the United States, determines that natural conditions such as annual precipitation and soil characteristics are sufficiently unstable so as to favor only slow and uncertain revegetation, he may recommend to the Mining Supervisor that the liability of the operator be extended for a period of up to five years beyond the period initially established, if the financial liability that would be incurred by the operator as a result is reasonably commensurate with the increased probability of successful revegetation.

(iii) During the relevant period of liability, the Mining Supervisor and the appropriate authorized officer shall jointly inspect and evaluate the revegetated areas pursuant to subsection 3041.6(b)(2) hereof.

(14) The operator shall: (i) Except as provided in subparagraph (ii) hereof, allow public access to and upon Federal lands subject to his lease, permit, or license for all lawful and proper purposes, except where such access would unduly interfere with his authorized use.

(ii) Regulate public access, vehicular traffic, and wildlife or livestock grazing in all areas of active operations, including lands undergoing reclamation, in order to protect the public, wildlife and livestock from hazards associated with such operations, and to protect revegetated areas from unplanned and uncontrolled grazing. For this purpose, the operator shall provide warning signs, fencing, flagmen, barricades, and other safety and protective measures as may be necessary.

(15) Coal storage areas shall be designed and maintained so as to eliminate fire hazards from spontaneous combustion and other accidental ignition. If a coal seam exposed by surface mining or an accumulation of slack coal or combustible waste becomes ignited during the term of a lease, the operator shall immediately take all necessary steps to extinguish the fire.

(16) Upon completion or temporary or permanent abandonment of mining operations in all or any part of a strip pit, the face of the coal shall be covered with noncombustible material that will effectively protect the coal bed from becoming ignited.

(17) The driving of any underground openings by auger or other methods from any strip pit shall not be undertaken except as specifically approved by the Mining Supervisor, in an approved plan.

§ 3041.3 Compliance or performance bond.

(a) The provisions of subpart 3504 of this Chapter are hereby made applicable to this subpart. In addition each compliance bond will be conditioned upon faithful compliance with the regulations in this subpart and any additional terms and conditions of the lease, permit, or license.

(b) Prior to issuing a lease, permit, or license, the authorized officer, after consultation with the Mining Supervisor, shall ensure that the amount of the compliance bond or bonds to be furnished is sufficient to ensure reclamation in accordance with the performance and reclamation standards in § 3041.2–2, and with the terms and conditions of the lease, permit, or license.

(c) An application for a lease, permit, or license may be denied any applicant or offeror who has previously forfeited a bond because of failure to comply with an approved plan unless the affected lands covered by such plan have been reclaimed without cost to the Federal Government. Nothing in this paragraph shall be deemed to modify or limit any discretionary authority of the authorized officer of the BLM otherwise to deny for cause any application for a lease, permit, or license.

(d) Once a lease, permit, or license has been issued the authorized officer, after consulting with and receiving the recommendation of the Mining Supervisor, shall take such action as may be necessary to increase or to release in whole or in part any compliance bond or bonds so that the amount of the compliance bond or bonds will at all times be sufficient to cover the estimated costs of completion of the remaining reclamation requirements of the approved plan and of the terms and conditions of the lease, permit, or license.

§ 3041.4 Procedures and public participation.

(a) Written findings. Except as may be otherwise expressly set forth in this subpart, decisions and determinations of any appropriate authorized officer acting pursuant to this subpart or to 30 CFR Part 211 with respect to issuance of leases, approval of mining plans or modifications thereof, and abandonment of operations shall be in writing, shall set forth with reasonable specificity the facts and the rationale upon which such decisions or determinations are based, and shall be available for public inspection during normal business hours at the offices of such officer.

(b) Availability of documents. Any application for a lease, permit, or license, together with the proposed terms, conditions, and special stipulations and any preliminary data submitted under § 3041.1–2 and reports made pursuant to § 3041.2 of this subpart shall be available for public inspection in the appropriate BLM office. To allow for such public inspection, a notice of the availability of any such documents shall be prepared by the appropriate officer of the BLM and promptly posted at his office and mailed to the surface owner, if other than the United States, to appropriate Federal and State agencies, and to the clerk or other appropriate officer in the county in which the proposed operation is located for posting or publication in accordance with the procedures of that office. No action with respect to such documents shall be taken for a period of 30 days after such posting and mailing. A copy of such notice shall be published by the applicant in a local newspaper of general circulation in the locality of the proposed operation at least once a week for four consecutive weeks.

(c) Public participation. (1) Upon the timely written request to the appropriate authorized officer of any person having an interest which is or may be adversely affected, a public meeting shall be conducted prior to issuance of a lease subject to the provisions of these regulations or determination of any specific terms and conditions thereof. A public meeting may be conducted prior to approval of final abandonment, including release of bonds, of any operation or portion thereof.

(2) Prior to the making of any decision or the taking of any action described in subparagraph (1) hereof, a notice of availability of such proposed decision or action shall be published in a newspaper of general circulation in the geographical area involved at least once in each of two consecutive weeks. In addition, not less than 20 days prior to the making of any such decision such notice shall be posed at the appropriate State or regional offices of the Bureau of Land Management and the Geological Survey, mailed to the operator, to all appropriate Federal and State agencies, including all agencies whose concurrence or consultation is sought or required, and to the surface owner if other than the United States; and published in the FEDERAL REGISTER. Such notice shall set a reasonable time period, not less than 20 days from the date of publication in the FEDERAL REGISTER, within which any person having an interest which is or may be adversely affected may, in writing, request a public meeting thereon.

(3) A complete transcript of any such public meeting, including any written comments submitted for the record, shal be kept and maintained available to the public during normal business hours at the appropriate Federal office under whose auspices such meeting is conducted, and shall be furnished at cost to any interested party. In making any decision or taking any action subject to such public meeting, the appropriate officer shall take into account all testimony submitted at such meeting, including any written comments submitted for the record. All such decisions and actions shal be subject to appeal pursuant to the provisions of Part 1850 of this Title.

(4) The public meeting requirements of paragraph (c)(1) of this section shal be deemed to have been satisfied if (a) a public hearing has been conducted upon an environmental statement pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969, as amended, or (b) public meetings in connection with a proposed Bureau of Land Management land use plan covering the affected lands, or in connection with selection of tracts for coal leasing under the Bureau's Energy Minerals Activity Recommendation System (EMARS) have been conducted, and provided tha during such hearing or public meetings all major issues and proposed terms and conditions have been considered, and with respect to which hearing or public meeting all notice requirements of thi section have been met.

§ 3041.5 Completion of operations and abandonment.

(a) Grading and backfilling. Upon completion of backfilling and grading as required by the approved plan and prior to replacing topsoil and revegetation the operator shall submit a report thereon, in duplicate, to the Mining Supervisor and request inspection for approval. Whenever it is determined by such inspection that the backfilling and grading has met the requirements of the approved plan, the Mining Supervisor shall recommend to the appropriate authorized officer release of an appropriate amount of the compliance bond for the area satisfactorily backfilled and graded

(b) Temporary abandonment. In areas in which there are no current operations, but operations are to be resumed under an approved plan, the operator shall substantially backfill, fence protect, or otherwise effectively close all surface openings, auger holes, areas prone to subsidence, and surface facilities or workings which are a hazard to people or animals. Conspicuous signs shall be posted prohibiting entrance of unauthorized persons. All such protective

isures shall be maintained in a secure
dition until such operations are re-
ied or permanently abandoned.

:) Permanent abandonment. Before
nanent abondonment of exploration
nining operations, all openings and
avations, including water discharge
its, shall be closed or backfilled, or
erwise permanently dealt with in ac-
lance with sound engineering prac-
s and according to the approved plan.
l holes, trenches, and other excava-
is for exploration, development or
specting shall be abandoned in such
anner as to protect the surface and
to endanger any present or future
erground operations or any deposit of
gas, other mineral resources, or
und water. Methods of abandonment
ll be approved in advance by the Min-
Supervisor in an approved plan, and
r include backfilling, regrading, re-
etation, cementing, and capped cas-
or combinations of these, or other
hods. Reclamation and clean-up of
ace areas around and near perma-
tly abandoned underground or sur-
mines, including, except where
erwise expressly provided in an ap-
ved plan, removal of equipment and
ictures related to the mining opera-
, shall commence without delay fol-
ing cessation of mining operations.
as affected by access roads will be
led, drained, and revegetated in ac-
lance with the approved Mining Plan
therein approved post mining land
prior to bond release. In the event
t access or haul roads are intended
emain after abandonment of the op-
ion, pursuant to § 3041.2–2(f)(11) of
subpart, they must be designed and
structed so as to be permanently
ilized using adequate drains, water
riers, and other practices.

l) Notice of abandonments release of
d. (1) Not less than 30 days prior to
ation or abandonment of operations,
operator shall submit to the Min-
Supervisor, in duplicate, a notice of
intention to cease or abandon op-
ions, together with a statement of
exact number of acres affected by his
rations, the extent and kind of recla-
ion accomplished, and a statement as
he structures and other facilities that
to be removed from or remain on the
ed, permitted, or licensed lands.

2) Upon receipt of such notice, the
ing Supervisor and the appropriate
horized officer or officers shall
mptly make a joint inspection to de-
nine whether all operations have
n completed in accordance with the
ns and conditions of all leases, per-
, and licenses, and with the require-
its of approved operating plan. Where
operator has complied with all such
ns, conditions and requirements and
regulations of this subpart, the Min-
Supervisor shall recommend to the
ropriate authorized officer that the
ropriate period of bonded liability be
ninated.

3) When the surface of lands in a
e, permit, or license is not owned
the United States, the Mining Super-
r shall notify the surface owner and solicit and take into account his comments before recommending to the appropriate authorized officer that the period of such bond liability be terminated.

§ 3041.6 Reports.

(a) Operations. The operator shall file with the Mining Supervisor, within 30 days after the end of each calendar year, and within 30 days after any temporary or permanent abandonment of operations, a report, in duplicate, containing the following with respect to his operations or the operations subject to such abandonment.

(1) Serial number of the lease, permit, or license and a description of the lands affected by operations.

(2) The number of acres disturbed and the number of acres reclaimed, including areas on which revegetation is being conducted.

(3) A description of the reclamation work remaining to be done on lands disturbed.

(b) Revegetation. (1) The operator shall file a report, in duplicate with the Mining Supervisor within 30 days after each planting is completed. The report shall:

(i) Identify the lease, permit, or license.

(ii) Show the types of planting or seeding, including mixtures and amounts.

(iii) Show the date of planting or seeding.

(iv) Identify or describe the planted or seeded lands.

(v) Describe any surface manipulation, mulching, fertilization, and irrigation procedures, if any, and contain such other information as may be considered relevant.

(2) The Mining Supervisor and the authorized officer of the Federal surface managing agency shall, as soon as possible after each full growing season, jointly inspect and evaluate the revegetated areas to determine, in consultation with the surface owner if other than the United States, whether satisfactory vegetative growth has been established, or whether additional revegetation efforts should be ordered pursuant to 30 CFR § 211.62(b)(2).

§ 3041.7 Notice of noncompliance: Revocation.

(a) The appropriate authorized officer and the Mining Supervisor shall have the right to enter upon the lands subject to this subpart under lease, permit, or license, at any reasonable time.

(b) If an appropriate authorized officer discovers that an operator is conducting on lands subject to this subpart activities which are not in compliance with the requirements of a lease, permit, or license, applicable regulations, or an approved plan and such activities do not threaten immediate and serious damage to the environment, resources, or the health and safety of the public, such authorized officer shall or, in the case of an appropriate authorized officer of any Federal surface managing agency not in the Department of the Interior, may refer the matter to the Mining Supervisor for remedial action pursuant to 30 CFR 211.72(a).

(c) If an appropriate authorized officer discovers that an operator is conducting on lands subject to this subpart activities which are not in compliance with the requirements of a lease, permit, or license, applicable regulations or an approved plan and such activities threaten immediate and serious damage to the environment, resources, or the health and safety of the public, and the Mining Supervisor is not available for appropriate remedial action pursuant to 30 CFR 211.72 (c), such authorized officer may order the immediate cessation of such activities and shall promptly notify the Mining Supervisor. Upon such notification, the Mining Supervisor shall order immediate remedial action pursuant to 30 CFR 211.72(c).

(d) Failure to the operator to take action in accordance with an order for cessation of activities issued pursuant to paragraph (c) of this section, or with a written notice of noncompliance issued by the Mining Supervisor in accordance with the provisions of 30 CFR 211.72 shall be grounds for suspension of the operation and for possible cancellation of the lease, permit, or license in accordance with the regulations in 43 CFR 3500 of this Chapter.

§ 3041.8 Variances.

(a) Variances from compliance with the performance standards set forth in this subpart may be allowed as part of an approved mining plan under either of the following circumstances:

(1) Where an applicant states in a proposed plan or modification thereof that he cannot meet a performance standard specified in paragraphs 3041.2–2(f) (2), (4), (6), (11), (12) or (13) of this subpart, he may request a variance from such performance standard where such variance would be compatible with the approved post mining land use, and shall support his request with appropriate information demonstrating the need therefor. The Mining Supervisor, after consultation with the appropriate authorized officer and the surface owner, if other than the United States, may approve or disapprove such variance, and shall advise the applicant and approve or disapprove the proposed plan or modification accordingly;

(2) Where an applicant proposes a post-mining land use that is substantially different from the land use immediately prior to any exploration and mining, the Mining Supervisor, with the concurrence of the appropriate authorized officer and after consultation with the surface owner, if other than the United States, may approve a mining plan containing variances from the performance standards of 30 CFR 211 and § 3041.2–2(f) hereof, provided that:

(A) After consultation with the appropriate land use planning agencies, if any, the proposed development is deemed to constitute an equal or better economic or public use of the affected land, as compared with the premining use.

(B) The granting of such variance is essential to achieving the proposed post mining land use.

(C) The applicant presents specific plans for the proposed post mining land use and appropriate assurances that such use will be:

(i) Compatible with adjacent land uses;

(ii) Supported by commitments and assured of investment from public agencies where appropriate;

(iii) Practicable with respect to private financial capability for completion of the proposed development;

(iv) Planned pursuant to a schedule made part of the proposed mining plan so as to integrate the mining operation and reclamation with the post mining land use;

(v) Designed by qualified personnel in conformance with professional standards in order to assure the stability, drainage, and configuration necessary for the intended use of the site.

(D) To the degree possible and taking into account the subjective nature of the assessment, the applicant has considered the impact of the proposed land use on the aesthetic character of the area by consulting with inhabitants of the area, and utilizing expertise in the landscape and geomorphologic fields.

(b) Any application for a variance pursuant to paragraph (a) of this Section shall demonstrate that any proposed disturbance of land above a highwall will facilitate compliance with the environmental protection and performance standards set forth in this subpart.

(c) Any application for variance pursuant to paragraph (a) of this Section which proposes to place spoil or other material on the downslope below the bench used to mine an area classed as "steep slope," shall demonstrate to the satisfaction of Mining Supervisor that the permanent or temporary sediment loads in the receiving drainages and reclamation to the post-mining land use will not have significant adverse effects upon the aesthetics of the area.

(d) All variances granted pursuant to this Section shall be reviewed by the Mining Supervisor and the appropriate authorized officer not more than three years after granting of the variance and incorporation in the mining plan, to ensure that the development is proceeding in accordance with the terms of the approved plan and the terms and conditions of any lease, permit, or license.

(e) An operator may apply for a variance pursuant to the provisions of paragraph (a) of this Section only by submitting a new or revised mining plan to the Mining Supervisor for approval pursuant to the provisions of 30 CFR 211. Minor changes of operations which do not involve violations of the performance standards set forth in this subpart, and the granting of a variance pursuant to the description in § 3041.2-2(a)(2) of this subpart, will not be deemed to be subject to or require compliance with, the provisions of this Section.

(f) If the Director of the GS determines that a decision to grant a variance would constitute a major Federal action significantly affecting the quality of the human environment, and that an environmental impact statement as required by section 102(2)(C) of the National Environmental Policy Act, has not been prepared with respect thereto, such a statement shall be prepared. If the Mining Supervisor grants a variance pursuant to this section, he shall notify the appropriate land managing agency or land planning agency for the purpose of determining whether any changes may, as a result of such variance, be required in any Management Framework Plan or equivalent land use plan.

Part 211 of 30 CFR is revised to read as follows:

Title 30—Mineral Resources

CHAPTER II—GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

PART 211—COAL MINING OPERATING REGULATIONS

Sec.

211.1 Scope and purpose.
211.2 Definitions.
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MAPS AND PLANS

211.10 Exploration and mining plans.
211.11 Approaching oil, gas, or water wells.
211.12 Mine maps.
211.13 Failure of lessee to furnish maps.

PROSPECTING AND EXPLORATION OPERATIONS

211.20 Information required to be submitted.
211.21 Core and test holes.

UNDERGROUND MINING

211.30 Maximum recovery.
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211.32 Multiple seam mining.
211.33 Advance workings.
211.35 Pillars left for support.
211.36 Development of leased tract through adjoining mines.

RECLAMATION AND PERFORMANCE STANDARDS

211.40 Operating and reclamation standards.
211.41 Completion of operations and abandonment.

REPORTS, RECORDS, ROYALTIES AND AUDITS

211.62 Reports.
211.63 Value basis for royalty computation.
211.64 Weight basis for royalty computation.
211.65 Audits.
211.66 Maintenance of and access to records.

INSPECTION, ISSUANCE OF ORDERS, ENFORCEMENT OF ORDERS AND APPEALS

211.70 Inspection.
211.71 Notices and orders.
211.72 Enforcement of orders.
211.73 Appeals.
211.74 Variances.
211.75 Applicability of State law.

§ 211.1 Scope and purpose.

(a) The regulations in this Part shall govern operations for the discovery, testing, development, mining, preparation, and handling of coal under leases, licenses, and permits issued for federally-owned coal, regardless of surface ownership, pursuant to the regulations in 43 CFR Group 3500 and the Alaska Coal Leasing Act of October 20, 1914, as amended (38 Stat. 741; 48 U.S.C. 432-445); and for the reclamation of lands disturbed by such operations. Except as may otherwise be provided in 25 CFR Chapter I, these regulations do not apply to operations for the discovery, testing, development, mining, preparation, and handling of coal in tribal and allotted Indian lands under leases and permits issued under the regulations in 25 CFR Parts 171, 172, and 174.

(b) The purpose of the regulations in this Part is to assure orderly and efficient prospecting, exploration, testing, development, mining, preparation and handling operations, and production practices, without avoidable waste or loss of coal or other mineral resources or damage to coal-bearing or other mineral-bearing formations, and without undue duplication or administrative delay by Federal officers and agents in review, approval or other actions provided for by this Part; to encourage maximum recovery and use of coal resources; to protect the public health and safety and to ensure effective and reasonable regulation of surface coal mining operations in accordance with the requirements hereof, as an appropriate and necessary means to minimize, so far as practicable, the adverse social, economic, and environmental effects of such operations; to require effective reclamation of affected lands as contemporaneously as practicable with coal development; to assure that all such operations which involve significant surface disturbance take place only pursuant to plans approved in advance thereof and only where reclamation of the affected lands to the standards set forth herein is attainable and assured; and to require a proper record and accounting of all coal produced.

(c) The responsibility for enforcement of the Federal Coal Mine Health and Safety Act of 1969 (83 Stat. 742; 30 U.S.C. 801) and the coal mine health and safety regulations contained in Chapter I of this Title is vested in the Mining Enforcement and Safety Administration, Department of the Interior.

(d) The provisions of this Part shall become effective upon the date of publication in the FEDERAL REGISTER as final rulemaking, except as hereinafter provided:

(1) Existing operations. (i) On and after 180 days from the effective date of this Part, the provisions of § 211.40(a) shall apply to all existing operations with respect to lands from which the overburden has not previously been removed, provided, however, that this paragraph shall not be deemed to apply the requirements of § 211.40(a) (1) and (2) hereof to any operation for which a mining plan has been approved on or before the effective date of this Part and for which a variance pursuant to the provisions of § 211.40(a)(2) would be required.

(ii) Except as may be required to comply with the provisions of paragraph (i), all existing operations shall be conducted pursuant to their approved plan. On or before 18 months from the effective date of this Part, the operator of each existing operation shall have obned the approval of a plan or modi- ation thereof which shall comply with of the provisions of this Part, pro- ed, however, that if the Director of Geological Survey determines that a posed new plan or modification of an sting plan was prepared and submit- in timely fashion, taking into account complexity of the operation and of plan or modification involved, but t administrative delay thereafter has vented approval within the time spec- d, such time period may be extended an amount of time equal to the ration of such delay.

iii) For the purpose of this para- ph, the term "existing operations" ll mean:

A) All operations for which a plan s been approved on or before the ef- tive date of this Part, and

(B) All operations with respect to ich a proposed plan has been sub- tted to the Department on or before effective date of this Part, and with pect to which proposed plan the De- rtment has on that date either com- ted its environmental impact analysis d determined that no environmental pact statement under section 102(2)) of the National Environmental licy Act is necessary, or has deter- ned that such a statement is necessary d has commenced, and expended sub- ntial resources of the Department in preparation or completion, of such tatement.

(iv) On or before August 16, 1976, the rector of the Geological Survey shall iew all proposed plans which have en submitted to the Department on or fore the effective date of this Part and er consultation with appropriate Fed- l surface managing agencies, publish the FEDERAL REGISTER a list which shall ntify each such proposed plan and ether it will be considered to cover a w or existing operation.

(2) All operations or proposed opera- ns not included in the definition of xisting operations" in the preceding ragraph shall be considered to be new erations, and shall be subject to the ovisions of this Part upon the effective te hereof.

(3) The provisions of § 211.72(c) shall ply immediately upon the effective te of this Part.

(e) To the maximum extent possible, l environmental impact statements and l approvals of plans covering existing erations which are pending before the epartment on the effective date of this rt shall take into account and shall flect and implement the provisions and rposes hereof, provided, however, that thing in this subparagraph shall be nstrued to relieve any operator of the ligation imposed by paragraph (d)(1)) above.

(f) Nothing in this Part shall be emed or construed to increase or minish any rights not in conflict with ederal law held by any person, includ- g any surface owner or entryman, aris- g under the laws of any State and re- ting to the giving or withholding of nsent to, or consultation in connection with, entry to any land for the purpose of conducting operations subject to this Part.

§ 211.2 Definitions.

As used in this Part, the following terms shall have the following meanings:

(a) *Acid or toxic producing materials* means natural or disturbed earth materials having chemical and physical characteristics that, under mining or post mining conditions of drainage, exposure, or other processes, may produce effluents that contain chemical constituents, such as acids, bases, or metallic compounds, in sufficient concentrations to individually or in combination adversely affect the environment.

(b) *Affected lands* means any lands affected or to be affected by exploration, development, and mining operations and the construction of facilities necessary and related to such operations.

(c) *Approximate original contour* means the surface configuration achieved by backfilling and grading of the mined area so that it closely resembles the surface configuration of the land prior to mining although not necessarily the original elevation) and blends into and complements the drainage pattern and topography of the surrounding terrain.

(d) *Area of operations* means that area of the leased, permitted, or licensed lands which is required for exploration, development, producing, and processing operations, including all related surface structures and facilities, and which is delineated on a map or plat that is made a part of the approved exploration or mining plan.

(e) *Authorized officer* means any officer designated by any Federal agency having administrative jurisdiction over lands or minerals to exercise its authority in matters relating to the provisions of this Part.

(f) *Coal* includes coal of all ranks from lignite to anthracite.

(g) *Compaction* means the reduction of porous spaces among the particles of soil and rock generally caused by running heavy equipment over the earth materials, as in the process of leveling the overburden material on strip mine spoil piles or banks, for the purpose of increasing the bearing capacity and stability of the earth materials.

(h) *Conservation Manager* means a Conservation Manager, Conservation Division, Geological Survey.

(i) *Contemporaneously as practicable* means, with respect to reclamation of mined or otherwise disturbed areas, the commencement, conduct, and completion of reclamation activity as soon after disturbance as possible, without undue physical interference with ongoing operations, leaving a minimum of land unreclaimed, consistent with the objectives of environmental protection set forth in this Part.

(j) *Daylighting* is a term used to define the surface mining procedure for exposing an underground mined area to remove remaining coal.

(k) *Director* means the Director of the Geological Survey, U.S. Department of the Interior.

(l) *Division Chief* means the Chief of the Conservation Division, Geological Survey.

(m) *Exploration* means the detailed investigation and acquisition of data pertaining to a mineral deposit, including activities for identifying regions or specific areas in which deposits are most likely to occur, and activities used to establish the nature of a coal deposit preparatory to mining.

(n) *Exploration plan* means a detailed plan submitted to the Mining Supervisor for approval before exploration operations commence showing the location and type of exploration work to be conducted, environmental protection procedures, roads, and reclamation procedures to be followed upon completion of such operations.

(o) *General Coal Mining Order* means a formal numbered order issued by the Mining Supervisor, with the prior approval of the Division Chief, and published, after opportunity for public comment, in the FEDERAL REGISTER, which implements the regulations in this Part and applies to coal mining and related operations in a specified geographic area.

(p) *Impoundment* means an artificially built, dammed, or excavated place for the retention of water or sediments. A permanent impoundment is one that is intended to remain after final abandonment of the operation, and shall be identified as such in an approved plan.

(q) *Leased lands, leased premises, or leased tract* means lands embraced within a coal lease and subject to the regulations in this Part.

(r) *Lessee* means any person or persons, partnership, association, corporation, or municipality to whom a coal lease is issued, subject to the regulations in this Part, or an assignee of such lease under an approved assignment.

(s) *Licensee* means any individual, association of individuals, or municipality to whom a coal license is issued pursuant to the provisions of section 208 of Title 30 of the United States Code.

(t) *Logical mining unit* means an area of land designated as such by the Geological Survey pursuant to applicable Departmental regulations.

(u) *Method of operation* means the method and manner by which any activities are performed by the operator, as described in an exploration or mining plan.

(v) *Mine* means an underground or surface excavation and the surface or underground support facilities that contribute directly or indirectly to coal mining, preparation, and handling.

(w) *Mining plan* means a detailed plan for development of the coal resource submitted to the Mining Supervisor for approval prior to commencement of any mining operation, showing the proposed location, method, and extent of mining and all related activities necessary and incidental to such operation, including steps to be taken to reclaim disturbed areas, to mitigate adverse impacts, and to otherwise meet the performance standards and requirements set forth in this Part.

(x) *Mining Supervisor* means the Area Mining Supervisor, Conservation Division, Geological Survey, or District Mining Supervisor or other subordinate acting under his direction.

(y) *Notice of Availability* means a formal notification, by the appropriate Federal officer, to appropriate Federal, State, and local agencies and interested individuals or groups of individuals, of the availability for inspection of information, data, proposed plans or modifications thereof, pending decisions and other documents subject to such notice. Any such notice shall include the nature of the information, data, plan or modification, decision or other document involved; the name and mailing address of any applicant, the nature, location (county, township, range, and section), duration and a brief description of any proposed operations; the date upon which any document involved was received and the date upon or after which any proposed action might be taken; and, when appropriate, a specific time limit for public review, comment, or request for any Departmental action, including the holding of any public meeting. For the purpose of ensuring appropriate distribution of such notices, there shall be maintained at each office of a Mining Supervisor or authorized officer of the Department of the Interior a mailing list which shall consist of the names and mailing addresses of all appropriate Federal, State, or local agencies and any individuals or groups of individuals who have requested in writing to be included on such lists. All notices of availability shall be mailed to such agencies, individuals, or groups at the addresses indicated on such lists.

(z) *Notice of noncompliance* means a written notice of operator noncompliance issued pursuant to § 211.72 of this Part.

(aa) *Operator* means a lessee, permittee, or licensee, or one conducting operations on lands under the authority of the lessee, permittee, or licensee.

(bb) *Overburden* means the earth, soil, rock, and other natural materials which lie above the coal being mined.

(cc) *Permanent abandonment* means the cessation of exploration or mining or other operations set forth in an approved plan on all or any portion of lands covered by a lease, permit, or license and subject to the provisions of this Part, where it is the intent of the operator not to continue operations at the mine or portion thereof.

(dd) *Permit lands* means lands embraced within a coal prospecting or other permit and subject to the regulations in this Part.

(ee) *Permittee* means any person or persons, partnership, association, corporation, or municipality to whom a coal prospecting or other permit subject to the regulations in this Part is issued, or an approved assignee of such permit.

(ff) *Pollution* means man-made or man-induced adverse alteration of the chemical, physical, biological, and radiological integrity of land, water, or air, which reduces, or has the potential of reducing, the beneficial uses of these resources.

(gg) *Post mining land use* means that use which will be made of the affected lands after mining and reclamation is completed and which is specified in a mining or exploration plan approved pursuant to this Part.

(hh) *Preparation* means any crushing, sizing, cleaning, drying, mixing, or other processing of coal to prepare it for market which is conducted on lands subject to this Part.

(ii) *Reclamation* means the process of returning affected lands to a stable condition and form consistent with their premining productivity and use, or other approved post mining land use.

(jj) *Road* means any open way for passage or travel upon which to transport people, equipment, materials, or coal, which is constructed, improved, or maintained by the operator and which is used to service the pit, bench, underground mine workings, loading facilities, or exploration activities.

(kk) *Secretary* means the Secretary of the Interior.

(ll) *Significant vegetation* means farm crops, including grasses and forbs, that are integral parts of agriculture or ranching operations and the natural vegetation of forests or meadows with significant recreational, watershed, agricultural, or wildlife habitat value.

(mm) *Spoil* means soil, rock, and other earth materials that are broken, moved, dumped, or otherwise significantly disturbed during surface coal mining operations subject to this Part.

(nn) *Subsidence* means a lowering of surface elevations over an underground mine caused by loss of support and subsequent caving of strata lying above the mine.

(oo) *Surface owner* means an entryman, or a person or persons who hold legal title to the land surface.

(pp) *Topsoil* means natural earth materials at or vertically adjacent to the land surface with physical and chemical characteristics suitable for support of vegetation.

(qq) *Valley floors* means the channelways, floodplains, and adjacent low terraces of streams that are flooded during periods of high flow and that are underlain by unconsolidated stream-laid deposits. Excluded are higher terraces and slopes underlain by colluvial and other surficial deposits normally occurring along valley margins.

(rr) *Waste* means solid or liquid refuse, rubbish, or other valueless material which is produced by or in connection with coal mining operations, including exploration, production, development, preparation and other related activities, and which has no useful purpose in connection with any remaining operations.

§ 211.3 Responsibilities.

(a) Subject to the supervisory authority of the Secretary, the regulations in this Part shall be administered by the Director, through the Division Chief, the Conservation Manager, and the Mining Supervisor.

(b) The Mining Supervisor is empowered to approve, disapprove, approve upon condition, or require modification of exploration and mining plans pursuant to the provisions of this Part.

(c) The Mining Supervisor is empowered to oversee prospecting, exploration, testing, development, mining, preparation, handling, reclamation, and abandonment operations subject to the provisions of this Part. The Mining Supervisor, in the performance of his duties, is authorized to consult with and solicit the views of other appropriate Federal, State and local agencies including the United States Environmental Protection Agency, and other interested parties, and shall:

(1) *Inspection of operations.* Examine, as frequently as necessary but at least quarterly, the lease, permit, or license lands where operations for the discovery, testing, development, mining, preparation, handling of coal, and reclamation of affected lands, are conducted, or are to be conducted; inspect such operations, for the purpose of determining whether waste or degradation of mineral substances or damage to formations and deposits or non-mineral resources affected by the operations is being minimized, and whether all provisions of applicable laws, regulations and orders, all terms and conditions of leases, permits, or licenses, and all requirements of approved exploration or mining plans are being complied with.

(2) *Compliance.* Require operators to conduct operations subject to this Part in compliance with all provisions of applicable laws, regulations, and orders, all terms and conditions of leases, permits, or licenses, and all requirements of approved exploration or mining plans.

(3) *Reports and recommendations.* Make reports to the Division Chief, through the Conservation Manager, as to the general conditions of lands under lease, permit or license, and the manner in which operations are being conducted and orders are being complied with; and submit information and recommendations for protecting the coal, the coal-bearing formations, other mineral resources, and the non-mineral resources. A copy of all such reports shall be furnished to the operator upon request, and shall be made available for public inspection during normal business hours at the Offices of the Mining Supervisor.

(4) *Manner and form of records, reports and notices.* Prescribe, subject to the approval of the Division Chief, the manner and form in which records of operations, reports, and notices shall be made.

(5) *Records of production; rentals and royalties.* Obtain and check coal production and sales records; determine rental and royalty liability of lessees and permittees; collect and deposit rental and royalty payments; maintain rental and royalty accounts.

(6) *Waiver, suspension, or reduction of rental or minimum royalty.* Act on applications for waiver, suspension, or reduction of rental or minimum royalty filed pursuant to 43 CFR 3503.3-2(d).

(7) *Suspension of operations and production.* Act on applications for suspension of operations or production, or both, filed pursuant to 43 CFR 3503.3-2(e), and terminate, when appropriate, suspensions which have been granted.

(8) *Cessation and abandonment of operations.* Upon receipt of notice of proposed abandonment of operations, or relinquishment of a lease, permit, or license, inspect and determine pursuant to § 211.41(d) hereof whether the operator has completed his operations in accordance with all applicable terms and conditions and whether all rentals and royalties due the lessor have been paid; determine and report to the appropriate authorized officer that the lands have been properly conditioned for abandonment; and recommend that the period of liability under the appropriate bond or bonds be terminated. Before taking any such action, the Mining Supervisor shall consult with and, where required, obtain the concurrence of, the appropriate authorized officer. When the surface of lands in a lease, permit or license is not owned by the United States, the Mining Supervisor shall, in addition, notify the surface owner, and shall solicit and take into account his comments and recommendations.

(9) *Wells or prospect holes.* Prescribe or approve the methods for protecting coal-bearing formations from damage or contamination that might be incurred as a result of any wells or prospect holes drilled to, or through, the coal-bearing formations for any purpose, on lands embraced within a coal lease, permit, or license.

(10) *Trespass.* Report to the appropriate authorized officer any trespass that involves exploration activities or removal of coal.

(11) *Water and air quality.* Inspect operations to determine compliance with air and surface and ground water management and pollution control measures required by the terms and conditions of applicable leases, permits, or licenses, and approved plans, and promptly notify appropriate representatives of other Federal and State agencies in the event of any noncompliance.

(12) *Implementation of regulations.* Issue General Coal Mining Orders and other orders, make determinations, and grant consents and approvals as necessary to implement or assure compliance with the regulations in this Part. Any oral orders, approvals, or consents shall be promptly confirmed in writing.

(13) *Compliance or performance bonds.* Determine whether the total amount of any bond or bonds furnished with respect to operations subject to this Part is at all times adequate to satisfy the estimated costs of completion of remaining reclamation requirements of the approved exploration or mining plan and the terms and conditions of the lease, permit, or license, and notify the appropriate authorized officer in the event of any inadequacies.

(14) *Consultation.* Consult with all appropriate authorized officers before taking any final action to approve an exploration or mining plan or modification thereof or to determine the appropriate amount of a compliance or performance bond or bonds. Any disagreements that cannot be resolved between the Geological Survey and the Bureau of Land Management arising in connection with any such final action or determination will be referred for resolution to the appropriate Assistant Secretaries or to the Under Secretary of the Department of the Interior. Any such disagreements between the Mining Supervisor and the appropriate authorized officer of any Federal surface management agency not in the Department of the Interior will be referred for resolution to comparable higher authorities in each agency, and, if necessary, to the respective Departments, for final resolution.

§ 211.4 General obligations.

(a) All operations involving the discovery, testing, development, mining, preparation and handling of coal, and the reclamation and abandonment of affected lands, shall be conducted pursuant to the obligations and standards of performance set forth in this Part, and shall conform to the provisions of all other applicable laws and regulations, including effluent and emission limitations; the terms and conditions of any applicable lease, permit, or license; the requirements of any applicable approved exploration or mining plan; and any orders issued by the Mining Supervisor.

(b) Coal mining operations shall be conducted so as to ensure the extraction of the coal resource to the maximum extent possible, taking into account existing technology, commercially available equipment, the cost of production, and the quality and quantity of coal resource, so that future environmental disturbance through the resumption of mining will be minimized.

(c) The operator shall take all actions necessary to minimize waste and damage to any remaining coal-bearing formations and other mineral resources.

(d) The operator shall take such action as may be needed to minimize, control, or prevent (1) soil erosion; (2) pollution of air; (3) pollution of surface or ground water; (4) serious diminution of the normal flow of water; (5) adverse impact upon fish and wildlife, especially threatened or endangered species, and their habitat; (6) permanent damage to vegetative growth, crops or timber; (7) creation of unsafe or hazardous conditions; (8) damage to improvements, whether owned by the United States, its permittees, licensees, or lessees, or by others; (9) damage to the recreational, cultural, scientific, historical, and known or suspected archaeological and paleontological values of the land; and (10) adverse impacts upon adjacent land uses. Good housekeeping practices shall be observed at all times. Where any question arises as to the necessity for, or the adequacy of, an action to meet the requirements of this paragraph, the determination of the Mining Supervisor shall be final, subject to the right of appeal as provided in Part 290 of this Title.

(e) The operator shall, when and as required by the Mining Supervisor, monitor water quality to establish data necessary to determine procedures which may be required to minimize, control, or avoid water pollution pursuant to the regulations in this Part.

(f) The operator shall promptly report to the Mining Supervisor by telephone accidents threatening damage to the mine, the lands or other resources, or accidents which could cause air or water pollution, along with corrective actions initiated. Within 30 days after any such accident the operator shall submit to the Mining Supervisor a detailed report of any damage caused by such accident and any corrective actions taken. The obligation set forth in this paragraph shall be in addition to any obligations which may arise pursuant to the Coal Mine Health and Safety Act of 1969 and any regulations promulgated thereunder.

(g) The operator shall submit the reports required by Part 200 of this Chapter, this Part, and any other reports required by the Mining Supervisor.

§ 211.5 Procedures and public participation.

(a) *Written findings.* Except as may be otherwise expressly set forth in this Part, all major decisions and determinations of any Mining Supervisor acting pursuant to this Part or to 43 CFR Subpart 3041 shall be in writing, shall set forth with reasonable specificity the facts and the rationale upon which such decisions or determinations are based, and shall be available for public inspection during normal business hours at the Offices of such Mining Supervisor.

(b) *Availabilty of proposed plans and major modifications of plans.* All proposed mining plans and major modifications thereof, and all modifications containing a request for a variance pursuant to the provisions of this Part, submitted under Section 211.10 of this Part shall be available for public inspection in the office of the appropriate Mining Supervisor. To allow for such public inspection, a notice of the availabilty of any such plan or modification shall be prepared by the Mining Supervisor and promptly posted at his office and mailed to the surface owner, if other than the United States, to appropriate Federal and State agencies, and to the clerk or other appropriate officer in the county in which the proposed operations are located for posting or publication in accordance with the procedures of that office. No action with respect to approval of any such plan or modification shall be taken by the Mining Supervisor for a period of 30 days after such posting and mailing. A copy of such notice shall be published by the operator in a local newspaper of general circulation in the locality of the proposed operation at least once a week for four consecutive weeks.

(c) *Public participation.* (1) Upon the timely written request to the appropriate Mining Supervisor of any person having an interest which is or may be adversely affected, a public meeting shall be conducted with respect to any of the following actions:

(i) Approval of a new or major modification, including any modification containing a request for a variance pursuant to § 211.74 hereof, of a previously approved exploration or mining plan.

(ii) Release of any substantial portion of a bond submitted pursuant to this Part covering obligations of performance or reclamation, including revegetation.

(iii) Aproval of final abandonment of any operation or portion thereof.

(2) Prior to the making of any decision or the taking of any of the actions described in paragraph (1) hereof, a notice of availability of such proposed decision or action shall be published in a newspaper of general circulation in the geographical area involved at least once in each of two consecutive weeks. In addition, not less than 20 days prior to the making of any such decision such notice shall be posted at the appropriate State or regional offices of the Bureau of Land Management and the Geological Survey; mailed to the operator, to all appropriate Federal and State agencies, including all agencies whose concurrence or consultation is sought or required, and to the surface owner if other than the United States; and published in the FEDERAL REGISTER. Such notice shall set a reasonable time period, not less than 20 days from the date of publication in the FEDERAL REGISTER, within which any person having an interest which is or may be adversely affected may, in writing, request a public meeting thereon.

(3) A complete transcript of any such public meeting including any written comments submitted for the record, shall be kept and maintained available to the public during normal business hours at the appropriate Federal office under whose auspices such meeting is conducted, and shall be furnished at cost to any interested party. In making any decision or taking any action subject to any such public meeting, the Mining Supervisor shall take into account all testimony submitted at such meeting, including any written comments submitted for the record. All such decisions or determinations shall be subject to appeal pursuant to the provisions of Part 290 of this Title.

(4) The public meeting requirements of subparagraph (1) of this subsection shall be deemed to have been satisfied if any public meeting, or a public hearing upon an environmental statement pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969, as amended, has previously been conducted, in which all major issues and proposed terms and conditions of any such proposed decision or action have been considered, and with respect to which meeting or hearing all notice requirements of this Section have been met.

§ 211.6 Confidentiality.

Geological and geophysical data and information, including maps, that may be used to calculate coal reserves in place, and trade secrets and commercial and financial information obtained from any person under this Part which is identified as privileged or confidential shall not be available for public inspection or made public or disclosed without the consent of the permittee, licensee, lessee or operator, provided however that upon termination of a permit, lease or license, whether by expiration of its terms or otherwise, or final abandonment of operations, resource and reserve data and information that may be used to calculate coal reserves in place submitted and so identified as privileged or confidential may be made available for public inspection or made public or disclosed. As used in this Section, "resource and reserve data and information" means geological and geophysical data and information, including maps, relating to the coal deposits within the permit or leased lands or covered by an approved plan which is abandoned. Requests for inspection of resource and reserve data and information shall be made in accordance with the regulations set forth in 43 CFR Part 2, which implement the Freedom of Information Act, as amended (5 U.S.C. 552).

MAPS AND PLANS

§ 211.10 Exploration and mining plans.

(a) *General.* (1) Before conducting any operation on leased, permitted or licensed lands other than casual use, the operator shall submit to the Mining Supervisor, and obtain his approval of, an exploration or mining plan. Casual use, as used in this subsection means activities which do not cause significant surface disturbance or damage to lands, resources and improvements, such as activities which do not include use of heavy equipment or explosives, or vehicular movement off established roads and trails which causes such disturbance. The operator shall submit seven copies of such plans. All such plans shall be identified by the name, address, and permit or lease number(s) of coal permits or leases included in the plan, and shall show in detail the proposed prospecting, exploration, testing, development, mining, preparation, reclamation, and abandonment operations to be conducted. Exploration or mining plans shall be consistent with and responsive to the requirements of the lease, permit, or license for maximizing recovery of mineral resources, for the protection of non-mineral resources, and for the reclamation of the surface of the lands affected by the operations. The exploration or mining plans shall show that reclamation is an integral part of the proposed operations and will progress as contemporaneously as practicable with such operations, and shall provide sufficient information to substantiate the effectiveness of the proposed reclamation method.

(2) The mining plan shall cover all operations to be conducted on a lease or in a logical mining unit, provided, however, that if the size of a lease or unit or the duration of a proposed operation make it impossible at the time of submission of a proposed plan to set forth in full and complete detail all of the specific information required to be submitted under paragraph (c) hereof with respect to the minor operational details of future operations, a proposed plan may be approved which sets forth only such information as is available at the time of submission, and further provided, that (i) The duration of the operations as to which full and complete information is set forth shall in no event be less than five years; (ii) the nature of the information as to which full and complete detail is not set forth, and the reasons therefor, shall be identified in the proposed plan and in any related notice of availability of any pending decision thereon; and (iii) the complete and detailed information not submitted shall be promptly submitted and made a part of the plan pursuant to the change in plan provisions of subparagraph (d)(2) hereof as soon as such information becomes available. Nothing in the preceding sentence shall be deemed to allow any operation other than casual use to be conducted in advance of approval of a plan or modification thereof which contains all such specific information with respect to such operation.

(b) *Exploration plans.* An exploration plan shall include all of the following:

(1) Names, addresses, and telephone number of persons responsible for operations under the plan and to whom notices and orders are to be delivered, and the names and addresses of surface owners of record and owners of record of sub-surface minerals, if other than the United States.

(2) A brief description, with maps where applicable, of geologic, water vegetation, and other physical factors and the distribution, abundance, and habitat of fish and wildlife, particularly threatened and endangered species, that may be affected by the proposed operation within the area where exploration is to be conducted, and the present land use within and adjacent to the area.

(3) A narrative description including (i) The method of exploration and types of equipment to be used.

(ii) The measures to be taken to prevent or control fire, soil erosion, pollution of surface and ground water, pollution of air, damage to fish and wildlife or their habitat and other natural resources, and hazards to public health and safety, including specific actions necessary to meet all applicable laws and regulations.

(iii) The method for plugging drill holes.

(iv) The measures to be taken for surface reclamation, which shall include as appropriate:

(A) A reclamation schedule.

(B) The method of grading, backfilling, soil stabilization, and compacting and contouring.

(C) The method of soil preparation and fertilizer application.

(D) The type and mixture of shrubs trees, grasses, forbs, or other vegetation to be planted.

(E) The method of planting, including approximate quantity and spacing

(4) The estimated timetable for each phase of the work and for final completion of the program.

(5) Suitable topographic maps or aerial photographs showing existing bodies of surface water, topographic, cultural, and drainage features, and the proposed location of drill holes, trenches and roads.

(6) Such other data as may be required by the Mining Supervisor.

(c) *Mining plans.* A mining plan shall include all of the following:

(1) Names, addresses, and telephone numbers of persons responsible for operations under the plan to whom notices and orders are to be delivered, and the names and addresses of surface owners of record, and owners of record of subsurface minerals, if other than the United States.

(2) A description, with maps and tables where appropriate, of the environment within the area where mining is to be conducted. Such description shall include, as a minimum, geologic conditions, including potential geologic hazards; types, depths, and distribution of soils; types, density, productivity, dominance, and distribution of vegetation; climatological data, including a monthly range of temperatures, precipitation and average direction and velocity of prevailing winds; and distribution, abundance and habitat of fish and wildlife, particularly threatened and endangered species.

(3) A description of the condition of the land covered by the mining plan, including:

(i) The uses existing at the time the mining plan is submitted for approval, and

(ii) The capability of the land immediately prior to any mining to support alternative uses, giving consideration to soil characteristics, including series, types, depths and distribution, topography, annual precipitation, and vegetative cover, including identification of dominant species.

(4) A description of the use which is proposed to be made of the land following reclamation, which shall take into account all applicable land use plans and programs.

(5) A description of how the proposed postmining land use is to be achieved, including any necessary support activities and facilities.

(6) A description of the proposed operation, including:

(i) The nature and extent of the coal deposit in terms of Btu content, ash, water, sulphur, volatile matter and carbon content, and including estimated recoverable reserves.

(ii) The method of mining, including mining sequence and proposed production rate.

(iii) The nature and timing of measures to be taken for surface reclamation, including as appropriate:

(A) A reclamation schedule, including the estimated timetable for each phase of the work and for final completion of the program.

(B) The method of grading, backfilling, soil stabilization, and compacting and contouring.

(C) The method of soil preparation and fertilizer application.

(D) The type and mixture of shrubs, trees, grasses, forbs, or other vegetation to be planted.

(E) The method of planting, including approximate quantity and spacing.

(iv) The engineering techniques proposed to be used in mining and reclamation, including the design and construction of roads, ditches, water retention facilities, dams, or settling ponds, and the control of water drainage and accumulation.

(v) A list of all major equipment.

(vi) An estimate of the cost per acre of reclamation including a separate breakdown for the cost of backfilling and grading, replacement of topsoil, seeding and/or planting, irrigation, fertilizing, and maintenance.

(vii) The method of operation and measures by which the operator plans to comply with the obligations and requirements set forth in §§ 211.4 and 211.40 of this Part and any special terms and conditions of the lease, permit, or license.

(viii) The anticipated starting and termination dates of each phase of the mining operation and number of acres of land to be affected.

(ix) The steps to be taken to comply with all applicable air and water quality laws and regulations.

(x) The measures for ensuring the maximum practicable recovery of the mineral resource.

(xi) The method of abandonment.

(xii) Logs and analyses of overburden samples of each stratum from a number of drill holes sufficient to obtain a representative sample of the overburden overlying the coal and the stratum immediately below the coal to be mined, which unless specifically authorized by the Mining Supervisor based upon data already known to the Geological Survey or upon the nature of the coal seam and geological inferences which may be drawn therefrom, shall be not less than one hole on each 40 acres. Such logs and analyses shall identify each stratum penetrated, and shall contain an analysis of each such stratum for at least the following: nitrogen, phosphorus, potassium, pH, specific conductance, exchangeable sodium percentage and sodium absorption ratio. Such analyses will be used to determine which materials shall be buried and which materials are suitable for placement near the surface for favorable propagation of vegetation.

(xiii) The hydrology of the area, including quantity and quality of water in surface and ground water systems, water levels and water table measurements, data regarding dissolved and suspended solids under seasonal flow conditions, and an assessment of the probable impacts of the anticipated mining operation upon the hydrology of the area.

(xiv) Plans for protecting oil, gas, and water wells as well as oil, gas, and underground water resources, when encountered.

(xv) Any justification for not recovering any coal deposits that may be detrimentally affected in terms of future recovery by the coal development operations proposed.

(7) Suitable topographic maps or aerial photographs showing:

(i) Topographic, cultural, archaeological, and natural drainage features, roads, and vehicular trails.

(ii) The name of the watershed and location of the surface stream or tributary into which mine waters will be discharged, if applicable.

(iii) Cross sections and plan views of the land to be affected, including the actual area to be mined, showing elevation and location of drill holes and depicting the following information: the nature and depth of the various strata of overburden; the nature and thickness and extent of any coal, or if rider seams above the specific coal proposed to be mined; the nature of the strata beneath the coal to be mined for a vertical distance of at least 20 meters beneath the base of the coal seam; the location of the next known deeper coal seam below the deepest seam to be mined and representative characteristics thereof; the location of any other mineral values encountered; hydrologic data and other information relevant to the mining plan; all mineral crop lines and the strike and dip of the coal to be mined within the area of land to be affected; location and extent of known surface and underground mine workings, oil or gas wells, and water wells within ¼ mile of the affected lands, the location of aquifers; the estimated elevation of the water table, and potentiometric surface; the location of spoil, waste, or refuse areas, and sequence of placement and topsoil preservation area; the location of all impoundments or water treatment facilities; constructed or natural drainways and the location of any discharges to any surface body of water on the area of land to be affected or adjacent thereto; and cross sections of the anticipated final surface configuration that will be achieved pursuant to the operator's proposed reclamation activities.

(iv) Locations of surface structures and facilities, including loading facilities.

(v) For an underground mine, in addition, the planned mine layout, including location and dimensions of shafts, slopes, drifts, crosscuts, rooms, haulageways, aircourses, entries, and barrier pillars.

(vi) If auger mining is proposed, the location and diameter of auger holes, the depth to be drilled, and the estimated percentage of recovery. In determining whether or not to approve proposed auger mining, the Mining Supervisor shall take into account the percentage of recovery, which shall in general exceed 30 percent, and probable adverse effects upon water quality.

(8) Any requests for variances from the performance standards of this Part.

(d) *Action on plans.* (1) The Mining Supervisor, after reviewing and considering a proposed plan and all comments received thereon, and after consultation with the appropriate authorized officer, shall in writing promptly approve or disapprove such plan. In approving such a plan the Mining Supervisor shall determine that such plan complies with all requirements of this Part, 30 CFR subpart 3041 and any lease, permit or license, and that reclamation as required thereby can be accomplished under the procedures set forth in such plan. The Mining Supervisor may impose such conditions upon such approval as may be necessary for the plan and operations to conform to the provisions of this Part and the terms and conditions of the lease, permit, or license. In disapproving such a plan, the Mining Supervisor shall indicate what modifications, if any, are necessary to, and would in fact, achieve such conformity. No such plan may be approved unless a bond executed pursuant to the provisions of 43 CFR subpart 3504, and conditioned upon compliance with all of the provisions of such plan, has been furnished to and approved by the appropriate authorized officer.

(2) *Changes in plans.* (i) *By Mining Supervisor.* Approved plans may be required to be reasonably revised or supplemented at any time by the Mining Supervisor, after consultation with the operator and the appropriate authorized officer, to adjust to changed conditions or to correct oversights.

(ii) *By the operator.* The operator may propose changes to an approved plan, and shall submit a written statement of any such proposed change and the justification therefor to the Mining Supervisor. The Mining Supervisor shall, after consultation with the appropriate authorized officer, in writing promptly approve or disapprove any such proposed change, or specify the modifications thereto under which it would be acceptable.

(iii) *By petition.* Any interested person may petition the Mining Supervisor to exercise the authority set forth in subparagraph (i) hereof. Any such petition shall be in writing, shall set forth the proposed revision, and shall state with reasonable particularity facts which demonstrate changed conditions or that oversights occurred at the time of approval which make modification necessary to bring the operation and plan into conformity with the obligations and requirements of this Part. Upon receipt of any such petition, the Mining Supervisor shall promptly decide whether the facts set forth are sufficient to warrant exercise of his authority pursuant to paragraph (i) above. A decision by the Mining Supervisor denying any such petition shall be considered a final decision of the Department.

(iv) *Public Notice.* If any change proposed under this subsection would constitute a major modification of an approved plan, or the grant of a variance pursuant to § 211.74 hereof, the Mining Supervisor shall follow the procedures provided in § 211.5(b) and (c) of this Part, and shall take any comments received into account in his decision.

§ 211.11 Approaching oil, gas, or water wells.

When mining operations are conducted in areas of known wells or bore holes that may liberate oil, gas, water or other fluid substances, the lessee shall include in his proposed plan all measures determined necessary by the Mining Supervisor in consultation with the appropriate Oil and Gas Supervisor of the Geological Survey to protect wells or bore holes, and obtain maximum recovery of the coal resource. If operations reveal unsuspected wells or bore holes, the operator shall promptly notify the Mining Supervisor and take no further actions which would disturb such wells or bore holes without his prior approval.

§ 211.12 Mine maps.

(a) *General requirements.* The operator shall maintain accurate and up-to-date maps of the mine, drawn to scales acceptable to the Mining Supervisor. All maps shall be appropriately marked with reference to government landmarks or lines and elevations with reference to sea level. Before a mine, or section of a mine, is abandoned, closed, or made inaccessible, a survey of such mine or section shall be made and recorded on such maps and a copy shall be furnished to the Mining Supervisor. All excavations in each separate bed shall be shown in such a manner that the production of coal for any royalty period can be accurately ascertained. Additionally, the maps shall show the name of the mine; the name of the lessee; the lease, permit, or license serial number; the lease boundary lines; surface buildings; dip of the bed; true north; map scale and explanatory legend; location, surface elevation, depth and thickness of the coal, and total depth of each borehole; auger holes; improvements; reclamation completed; topography, including subsidence resulting from mining; and the geologic and hydrologic conditions as determined from outcrops, drill holes, exploration or mining; water monitoring stations and such other information as the Mining Supervisor may request. Copies of such maps shall be properly posted to date and furnished, in duplicate, to the Mining Supervisor annually, or at such other times as he may request.

(b) *Underground mine maps.* Underground mine maps shall, in addition to the general requirements of paragraph (a) of this Section, show all mine workings; the date of extension of the mine workings and a coal section at each entry face; the location of all surface mine fans; the position of all fire walls, dams, main pumps, fire pipelines, permanent ventilation stoppings, doors, overcasts, undercasts, permanent seals, and regulators; the direction of the ventilating current in the various parts of the mine at the time of making the latest surveys; sealed areas; known bodies of standing water, either in or above the workings of the mine; areas affected by squeezes; the elevations of surface and underground levels of all shafts, slopes or drifts, and the elevation of the floor, or bottom of the mine workings, at regular intervals in main entries, panels or sections, and sump areas. Any maps submitted to the Mining Enforcement and

Safety Administration for the purpose
showing, and which in fact show, a
of the specific data required by this su
paragraph shall be acceptable in fulfi
ment of the requirements hereof.

(c) *Surface mine maps.* Surface mi
maps shall, in addition to the gene
requirements of paragraph (a) of t
Section, include the date of extension
the mine workings and a detailed stra
graphic section at intervals specified
the approved mining plan. Such sectio
shall include the highwall; all worked
and reclaimed areas; the uncovered, b
unmined, coal beds; and the elevati
of the top of the coal beds.

(d) *Vertical projections and cross s*
tions of mine workings. When requi
by the Mining Supervisor, vertical pr
jections and cross sections shall acco
pany plan views.

(e) *Accuracy of maps.* The accuracy
maps furnished shall meet accepta
standards and shall be certified by
professional engineer, professional la
surveyor, or other professionally qua
fied person.

§ 211.13 Failure of lessee to furn maps.

(a) *Liability of lessee for expense*
survey. If the operator fails to furnish
required or requested map, the Mini
Supervisor shall employ a professiona
qualified person to make the requi
survey and map, the cost of which sh
be charged to, and promptly paid by, t
operator.

(b) *Incorrect maps.* If any map su
mitted by an operator is believed to be i
correct, the Mining Supervisor may e
ploy a professionally qualified person
make a survey and any necessary ma
If the survey shows the maps submitt
by the lessee to be substantially inco
rect, in whole or in part, the cost of ma
ing the survey and preparing the ma
shall be charged to, and promptly pa
by, the operator.

PROSPECTING AND EXPLORATION OPERATIONS

§ 211.20 Information required to be su mitted.

The operator shall submit promptly
the Mining Supervisor, upon reque
upon completion or suspension of pro
pecting or exploration operations, or
provided in his lease, permit, and licens
duplicate signed copies of records a
geologic interpretations of all prospec
ing and exploration operations perform
on the lease or permit lands, includi
recoverable reserve calculations, alo
with vertical cross sections through t
land and a map showing the location
coal outcrops, all drill holes, trench
and other exploration activities. The re
ords shall include a log of all strata pen
trated and conditions encountered, su
as water, quicksand, gas, or any unusu
conditions; copies of all other in-ho
surveys, such as electric logs, gamma ra
neutron logs, sonic logs, or any oth
logs produced; and copies of coal analy
ses and results of other tests conducte
on the land. All drill holes, trenches, a
excavations will be logged under the s

pervision of a qualified geologist or engineer. Unless otherwise authorized by the Mining Supervisor, representative samples of all drill cores or cuttings shall be retained by the operator for one year and shall be available for inspection or analysis at the convenience of the Mining Supervisor. Confidentiality of such information will be accorded pursuant to the provisions of § 211.6 of this Part.

§ 211.21 Core and test holes.

(a) *Surveillance wells.* With the approval of the Mining Supervisor, drill holes may be utilized as surveillance wells for the purpose of monitoring the effect of subsequent operations upon the quantity, quality, or pressure of ground water or mine gases.

(b) *Blowout control devices.* When drilling on lands valuable or potentially valuable for oil and gas or geothermal resources, the operator shall, when required by the Mining Supervisor, set and cement casing in the hole and install suitable blowout prevention equipment.

(c) *Use of wells by others.* Upon receipt of a written request from the surface owner or the appropriate authorized officer, the Mining Supervisor may approve the transfer of an exploratory well for further use as a water well. Approval of such well transfer will be accompanied by a corresponding transfer of responsibility for any liability for damage and eventual plugging. Nothing in this paragraph shall be deemed to supercede or affect the applicability of any State law requirements with respect to such transfer.

UNDERGROUND MINING

§ 211.30 Maximum recovery.

Underground mining operations shall be conducted so as to yield the maximum recovery of the coal deposits consistent with the protection and use of other natural resources, sound economic practice, and the protection of the environment—land, water, and air. No entry, level, or panel workings in which the pillars have not been completely extracted within safe limits shall be permanently abandoned or rendered inaccessible, except with the prior written approval of the Mining Supervisor.

§ 211.31 Subsidence.

(a) Each operator of an underground coal mine shall adopt measures consistent with feasible known technology in order to prevent or, in those instances where the mining method used requires planned subsidence in a predictable and controlled manner, control subsidence; maximize mine stability; and maintain the value and use of surface lands.

(b) Where pillars or panels are not removed, and controlled subsidence is not part of the mining plan, pillars or panels of adequate dimensions shall be left for surface stability, giving due consideration to the thickness and strength of the coal beds and of the strata above and immediately below the coal bed.

(c) The Mining Supervisor may require the operator to install a subsidence monitoring system consisting of elevation stations and tiltmeters in a number sufficient to determine the extent of any area that may be affected. All records of such surveys shall be accessible for review by the Mining Supervisor.

§ 211.32 Multiple seam mining.

(a) *Sequence of mining.* In general, the available coal in the upper beds shall be worked out before the coal in the lower beds is mined, and simultaneous workings in an upper coal bed shall be kept in advance of the workings in each lower bed. The Mining Supervisor may authorize mining of any lower beds before mining the available coal in each known upper bed.

(b) *Protective barrier pillars in multiple seam mining.* In areas subject to multiple seam extraction, the protective barrier pillars for all main and secondary slope entries, main haulageways, primary aircourses, bleeder entries and manways in each seam shall be superimposed, regardless of vertical separation or rock competency; however, modifications, exceptions, or variations of this requirement may be approved in advance by the Mining Supervisor.

§ 211.33 Advance workings.

Where the room and pillar or other system of mining requires advance workings in solid coal, including entries, rooms or crosscuts, the lessee shall leave sufficient pillars to ensure the maximum practicable recovery of the coal deposits, upon retreat.

§ 211.35 Pillars left for support.

(a) *Barrier pillars.* The operator shall not, without the prior consent of the Mining Supervisor, mine any coal, drive any underground workings, or drill any lateral bore holes within 50 feet of any of the outside boundary lines of the leased lands, or within such greater distance of said boundary lines as the Mining Supervisor may prescribe. Payment up to and including the full value of the coal mined may be required for coal mined within such designated distances of the boundary without the written consent of the Mining Supervisor.

(b) *Lessee may be required to mine barrier pillars on adjacent lands.* If the coal beyond any barrier pillar has been worked out and the water level beyond the pillar is below the lessee's adjacent operations, the lessee shall, on the written order of the Mining Supervisor, mine out and remove all available Federal coal in such barrier, both in the lands covered by the lease and in the adjoining premises, if it can be mined without undue hardship to the lessee.

(c) *Privately or Indian owned coal on adjoining premises.* If the coal in adjoining premises is privately or Indian owned and this coal has been worked out, an agreement may be made with the coal owner for the extraction of the cost remaining in the boundary pillars which otherwise may be lost.

§ 211.36 Development of leased tract through adjoining mines.

An operator may, with the approval of the Mining Supervisor, mine leased lands from an adjoining underground mine on land privately owned or controlled or from adjacent leased lands, subject to the right of free access to the Federal premises by the Mining Supervisor.

RECLAMATION AND PERFORMANCE STANDARDS

§ 211.40 Operating and reclamation standards.

(a) *Performance standards.* The following performance standards shall be applicable to all coal exploration, development, mining, preparation, handling, and reclamation operations on the surface of land subject to this Part, including the surface effects of underground mining:

(1) The operator shall reclaim affected lands pursuant to his approved plan, as contemporaneously as practicable with operations, to a condition capable of supporting all practicable uses which such lands were capable of supporting immediately prior to any exploration or mining, or equal or better uses that have been approved in accordance with this Part.

(2) The operator shall replace overburden and waste materials in the mined area by backfilling (compacting, where necessary, to ensure stability or to prevent leaching of toxic materials), grading, or other means, so as to cover all acid-forming or other toxic materials, eliminate highwalls and spoil piles and restore the approximate original contour. Where the thickness of the coal deposits relative to the volume of overburden is large and where the overburden and other spoil and waste materials are either insufficient or more than sufficient to restore the approximate original contour, the operator shall, in order to provide adequate drainage, backfill, grade, and, where necessary, compact, using all available overburden or spoil material, to obtain the lowest practicable grade, which shall in any event be less than the angle of repose. Excess overburden or other spoil material shall be fully reclaimed in accordance with the requirements of this Part. Variance from the requirements of paragraphs (1) and (2) of this subsection may be allowed in an approved mining plan if the Director of the Geological Survey, with the concurrence of the Director of the Bureau of Land Management or the comparable appropriate authorized officer, determines that unusual physcial conditions at the site, such as steeply dipping coal beds or multiple seam mining, exist, and such conditions make backfilling pursuant to such requirements impracticable as a result of the volume of material excavated or environmentally undesirable as a result of the duration of the operation.

(3) The operator shall stabilize and protect all surface areas, including spoil piles, affected by the coal mining and reclamation operation, to effectively control slides, erosion, subsidence, and attendant air and water pollution.

(4) The operator shall remove topsoil separately, for replacement on the back-

fill area, and if not so utilized immediately, segregate it in a separate pile from other soil. When topsoil is not to be replaced on a backfill area within a time short enough to avoid deterioration, the operator shall establish and maintain an approved quick growing vegetative cover or employ other approved measures so that the topsoil is protected from wind and water erosion and establishment of noxious plant species, and is in a condition for sustaining vegetation when used during reclamation. If topsoil is of insufficient quantity or of poor quality for sustaining vegetation, and if other excavated materials can be shown to be more suitable for revegetation, then the operator may be authorized in the approved plan to remove, segregate, protect, and utilize in a like manner such other material.

(5) The operator shall utilize water impoundments, water retention facilities, dams, or settling ponds only pursuant to an approved plan, and shall ensure that:

(i) Such facility is adequate for its intended purposes and the quality and quantity of impounded water will be suitable for its intended use.

(ii) Such facility is designed, located, built, used, and maintained in accordance with sound engineering standards and practices and applicable Federal and State laws and regulations to ensure that such facilities will have necessary stability with an adequate margin of safety.

(iii) Final grading will provide adequate safety and access for proposed or reasonably anticipated water users.

(iv) Such facilities will not have a significant adverse impact on the water resources utilized by adjacent or surrounding landowners for agricultural, industrial, recreational, or domestic uses, provided, however, that this subparagraph shall not be deemed or construed to increase or diminish any property rights to any water held by any person.

(v) No mine or processing waste is used in the construction of such facilities unless authorized in the approved plan.

(6) The operator shall cover or plug all auger mine holes with noncombustible and, where necessary to minimize, control or prevent harmful drainage, impervious material.

(7) The operator shall utilize the best practicable commercially available technology to minimize, control, or prevent disturbances of the prevailing quality, quantity, and flow of water in surface and ground water systems, and of the prevailing erosion and deposition conditions at the mine site and in affected offsite areas, both during and after coal mining operations and reclamation, by:

(i) Controlling acid or toxic drainage and the adverse consequences thereof by such measures as, but not limited to, diverting surface runoff water away from disturbed areas; excluding oxygen from, or restricting the flow of water through, acid or toxic-producing materials; treating drainage to reduce acid or toxic content which adversely affects downstream water upon being released to water courses; and casing, sealing, or otherwise treating drill holes, shafts, and walls to keep acid or toxic drainage from entering ground and surface waters.

(ii) Conducting surface mining operations so as to minimize, control, or prevent (A) contributions of suspended solids to streamflow or runoff outside the mining site above natural levels under seasonal flow conditions as measured for a period and at sites determined by the Mining Supervisor, in consultation with the appropriate authorized officer, and (B) except where specifically authorized in an approved plan, deepening or enlarging of stream channels where operations include the discharge of water from mines.

(iii) Removing or modifying siltation structures after disturbed areas are revegetated and stabilized unless otherwise authorized by the Mining Supervisor in an approved plan, with the concurrence of the appropriate authorized officer, provided, however, that any siltation structure retaining water shall in any event be subject to the requirements of § 211.40(a)(5) of this section.

(iv) Protecting the quality, quantity, and flow, including depth of flow, of both upstream and downstream surface and ground water resources of those valley floors which provide water sources that support significant vegetation or supply significant quantities of water for other purposes, by such measures as, but not limited to, relocating and maintaining the gradients of streams, avoiding mining, installing, reestablishing, or replacing aquifers or aquiludes, and replacing soil, provided, however, that this subparagraph shall not be deemed or construed to increase or diminish any property rights to any water held by any person.

(8) The operator shall: (i) Treat or dispose of all rubbish and noxious substances in a manner designed to minimize, control, or prevent air and water pollution and the hazards of ignition and combustion.

(ii) Dispose of all waste resulting from the mining and preparation of coal in a manner designed to minimize, control, or prevent air and water pollution and hazards of ignition and combustion. Where surface disposal of solid wastes in areas other than the mine workings or other excavations has been authorized in the approved plan, stabilize such waste including, where necessary, constructing waste piles in compacted layers with the use of incombustible and impervious materials; shape waste piles to be compatible with the natural surroundings and terrain; cover with topsoil or other suitable material in accordance with paragraph (a)(4) of this section, and revegetate in accordance with paragraph (a)(13) of this section. All impoundments of liquid wastes shall comply with the requirements of paragraph (a)(5) of this section. Waste containing coal in such quantity that it may be later separated from the waste by washing or other means shall be stored separately.

(9) Except as provided herein, th operator shall not conduct excavatio drilling, or blasting operations withi 200 feet of an active or abandoned unde ground mine. Where it can be establishe by certified maps or inspection of suc an underground mine that such activiti may be conducted without danger of i terference with, or penetration of, a underground mine, they may be autho ized in an approved plan to be conducte up to but not less than 25 feet from suc underground mine, provided that noth ing in this paragraph shall preclude da lighting or similar surface coal minin activities intended to improve resour recovery, abate water pollution, or elim nate public hazards resulting from suc underground mines.

(10) To prevent personal injury damage to public and private propert the operator shall use explosives only accordance with all applicable Feder and State laws and an approved pla and shall:

(i) Provide adequate advance writte notice by publication and/or posting planned blasting schedules, to local go ernments and to residents who migl be affected by the use of such explosive and maintain a log of the magnitud and times of blasts for a period of at lea two years.

(ii) Limit the size, timing, and fr quency of blasts, as determined by th physical conditions of the site.

(11) The operator shall design to ap plicable standards, construct, maintai and, when no longer necessary and u less otherwise authorized in an approve plan, remove all roads, pipelines, powe lines and similar utility access faciliti and associated bridges, culverts, an ditches, into and across the site of oper tions, in a manner that will minimiz control, or prevent erosion and siltatio fugitive dust, pollution of water, dama to fish or wildlife or their habitat an public or private property.

(12)(i) Roads shall not be surface with any acid or toxic producing mate rial. No access roads will be constructe unless (A) the operator shall have fir submitted a surveyed profile accom panied by typical cross-sections of th road and ditches, showing pipe, entranc and exit channels and sediment contr structures and other structures or co figurations to be used on the road to mee performance standards and (B) th location shall have been marked, and in spected and approved by the Minin Supervisor, in consultation with the ap propriate authorized officer and the sur face owner, if other than the Unite States.

(ii) No access road shall be constructe in a stream, nor shall any stream o stream bed be used as an access road. In sofar as possible, all roads shall b located on benches, ridges, and flatte slopes to enhance stability and minimiz disturbance. Stream fordings shall b avoided and the normal seasonal flo and the normal seasonal sediment loa shall not be detrimentally affected by ac cess roads in a continuous fashion tha results in harm to the aquatic ecosystem, provided, however, that nothing in this subparagraph shall be construed to prohibit relocation or alteration of such beds or channels pursuant to the provisions of this Part and as set forth in an approved plan.

(13) (i) The operator shall, except where other reclamation based upon post mining land use and not requiring revegetation pursuant to the requirements of this section is expressly provided for in an approved plan, establish on regraded area and all other affected lands a diverse vegetative cover, native to the area and capable of regeneration and plant succession, at least equal in density and permanence to the natural vegetation; provided, however, that the Mining Supervisor with the concurrence of the appropriate authorized officer may allow the use of approved mixtures of introduced or native species where preferable to achieve quick cover or assure successful revegetation. In approving such mixture, preference will be given to non-noxious species.

(ii) The operator's responsibility and liability under his performance bond for revegetation of each planting area shall extend until such time as the appropriate authorized officer, in consultation with the Mining Supervisor and the surface owner if other than the United States, determines that successful revegetation in compliance with paragraph (a) (13) (i) of this section has occurred, provided, however, that this period shall extend for a minimum of five full years after the first planting, and for a total period of liability not to exceed 10 years from the original planting; and further provided that,

(A) Where the appropriate authorized officer, in consultation with the Mining Supervisor, determines that natural conditions such as annual precipitation, soil characteristics, and native vegetation are stable and favor rapid revegetation, and that revegetation pursuant to paragraph (i) of this section is likely to occur before the expiration of such minimum period, he may specify in the lease, permit, or license that such minimum period will not apply with respect to some or all of the lands included in such lease, permit, or license; and

(B) where during any such minimum period such authorized officer, in consultation with the Mining Supervisor and the surface owner, if other than the United States, determines that natural conditions such as annual precipitation and soil characteristics are sufficiently unstable so as to favor only slow and uncertain revegetation, he may recommend to the Mining Supervisor that the liability of the operator be extended for a period of up to five years beyond the period initially established, if the financial liability that would be incurred by the operator as a result is reasonably commensurate with the increased probability of successful revegetation.

(iii) During the relevant period of liability, the Mining Supervisor and the appropriate authorized officer shall jointly inspect and evaluate the revegetated areas pursuant to § 211.62(b)(2) hereof.

(14) The operator shall: (i) Except as provided in paragraph (ii) hereof, allow public access to and upon Federal lands subject to his lease, permit, or license for all lawful and proper purposes, except where such access would unduly interfere with his authorized use.

(ii) Regulate public access, vehicular traffic and wildlife or livestock grazing in all areas of active operations, including lands undergoing reclamation, in order to protect the public, wildlife and livestock from hazards associated with such operations, and to protect revegetated areas from unplanned and uncontrolled grazing. For this purpose, the operator shall provide warning signs, fencing, flagmen, barricades and other safety and protective measures as may be necessary.

(15) Coal storage areas shall be designed and maintained so as to eliminate fire hazards from spontaneous combustion and other accidental ignition. If a coal seam exposed by surface mining or an accumulation of slack coal or combustible waste becomes ignited during the term of a lease, the operator shall immediately take all necessary steps to extinguish the fire.

(16) Upon completion or temporary or permanent abandonment of mining operations in all or any part of a strip pit, the face of the coal shall be covered with noncombustible material that will effectively protect the coal bed from becoming ignited.

(17) The driving of any underground openings by auger or other methods from any strip pit shall not be undertaken except as specifically approved by the Mining Supervisor in an approved plan.

§ 211.41 Completion of operations and abandonment.

(a) *Grading and backfilling.* Upon completion of backfilling and grading as required by the approved plan and prior to replacing topsoil and revegetation, the operator shall submit a report thereon, in duplicate, to the Mining Supervisor and request inspection for approval. Whenever it is determined by such inspection that the backfilling and grading has met the requirements of the approved plan, the Mining Supervisor shall recommend to the appropriate authorized officer release of an appropriate amount of the compliance bond for the area satisfactorily backfilled and graded.

(b) *Temporary abandonment.* In areas in which there are no current operations, but operations are to be resumed under an approved plan, the operator shall substantially backfill, fence, protect, or otherwise effectively close all surface openings, auger holes, areas prone to subsidence, and surface facilities or workings which are a hazard to people or animals. Conspicuous signs shall be posted prohibiting entrance of unauthorized persons. All such protective measures shall be maintained in a secure condition until such operations are resumed or permanently abandoned.

(c) *Permanent abandonment.* Before permanent abandonment of exploration or mining operations, all openings and excavations, including water discharge points, shall be closed or backfilled, or otherwise permanently dealt with in accordance with sound engineering practices and according to the approved plan. Drill holes, trenches, and other excavations for exploration, development, or prospecting shall be abandoned in such a manner as to protect the surface and not to endanger any present or future underground operations or any deposit of oil, gas, other mineral resources, or ground water. Methods of abandonment shall be approved in advance by the Mining Supervisor in an approved plan, and may include backfilling, regrading, revegetating, cementing, and capped casing, or combinations of these, or other metthods. Reclamation and clean-up of nently abandoned underground or surfa surface areas around and near permanently abandoned underground or surface mines, including, except where otherwise expressly provided in an approved plan, removal of equipment and structures related to the mining operation, shall commence without delay following cessation of mining operations. Areas affected by access roads will be graded, drained, and revegetated in accordance with the approved mining plan and therein approved post mining land use prior to bond release. In the event that access or haul roads are intended to remain after abandonment of the operation, pursuant to § 211.40 of this Part, they must be designed and constructed so as to be permanently stabilized, using adequate drains, water barriers, and other practices.

(d) *Notice of Abandonment; release of bond.* (1) Not less than 30 days prior to cessation or abandonment of operations, the operator shall submit to the Mining Supervisor, in duplicate, a notice of his intention to cease or abandon operations, together with a statement of the exact number of acres affected by his operations, the extent and kind of reclamation accomplished, and a statement as to the structures and other facilities that are to be removed from or remain on the leased, permitted, or licensed lands.

(2) Upon receipt of such notice, the Mining Supervisor and the appropriate authorized officer or officers shall promptly make a joint inspection to determine whether all operations have been completed in accordance with the terms and conditions of all leases, permits, or licenses, and with the requirements of the approved operating plan. Where the operator has complied with all such terms, conditions, and requirements, and the regulations of this Part, the Mining Supervisor shall recommend to the appropriate authorized officer that the appropriate period of bonded liability be terminated.

(3) When the surface of lands in a lease, permit, or license is not owned by the United States, the Mining Supervisor shall notify the surface owner and solicit and take into account his com-

ments before recommending to the appropriate authorized officer that the period of such bond liability be terminated.

REPORTS, RECORDS, ROYALTIES AND AUDITS

§ 211.62 Reports.

(a) *Operations.* The operator shall file with the Mining Supervisor within 30 days after the end of each calendar year and within 30 days after any temporary or permanent abandonment of operations, a report, in duplicate, containing the following with respect to his operations or the operations subject to such abandonment.

(1) Serial number of the lease, permit, or license and a description of the affected lands.

(2) The number of acres disturbed and the number of acres reclaimed, including areas on which revegetation is being conducted.

(3) A description of the reclamation work remaining to be done on lands disturbed.

(b) *Revegetation.* (1) The operator shall file a report, in duplicate, with the Mining Supervisor within 30 days after each planting is completed. The report shall:

(i) Identify the lease, permit, or license.

(ii) Show the types of planting or seeding, including mixtures and amounts.

(iii) Show the date of planting or seeding.

(iv) Identify or describe the planted or seeded lands.

(v) Describe any surface manipulation, mulching, fertilization, and irrigation procedures, if any, and contain such other information as may be considered relevant.

(2) The Mining Supervisor and the authorized officer of the Federal surface managing agency shall, as soon as possible after each full growing season, inspect and evaluate the revegetated areas to determine, in consultation with the surface owner if other than the United States, whether satisfactory vegetative growth is being established, or whether additional revegetation efforts should be ordered by the Mining Supervisor.

(c) *Production and payments.* (1) *Lessees and permittees.* Lessees and permittees shall report, on the report form provided, within 30 days after expiration of the period covered by the report, all coal mined during each calendar quarter and the basis on which royalty has been paid or will be paid. The royalty for coal mined shall be paid on or before the end of the third month succeeding the extraction of the coal.

(2) *Licensees.* Licensees shall report all coal mined on a semi-annual basis on the report form provided.

(3) *Penalty.* If a lessee or permittee records or reports less than the true weight or value of coal mined, the Secretary may impose a penalty equal to either double the amount of royalty due on the shortage, or the full value of the shortage. If, after notice, a lessee or permittee maintains false records or files false reports, the Mining Supervisor may recommend that action be initiated to cancel the lease or permit, in addition to the imposition of any penalties.

§ 211.63 Value basis for royalty computation.

(a) Where only crushing, storing, and loading are performed prior to the point of sale, the value of the coal for royalty purposes shall be the gross value at the point of sale. However, if additional processing of the coal is performed prior to sale, such as washing to remove waste, bone, or other impurities, the processing cost above the cost of primary crushing, storing, and loading may be deducted from the gross value in determining value for royalty purposes. The Mining Supervisor will allow such deductions only when, in his judgment and subject to his audit, the lessee provides him an accurate account of the costs so incurred.

(b) The gross value shall be the sale or contract unit price times the number of units sold, provided, however, that where the Mining Supervisor determines (i) that a contract of sale or other business arrangement between the lessee and a purchaser of some or all of the coal produced from the lease is not a bona fide transaction between independent parties because it is based in whole or in part upon considerations other than the value of the coal, or (ii) that no consideration is received for some or all of such coal because the lessee is consuming such coal for his own use or adding it to inventories, the Mining Supervisor shall determine the gross value of such coal, taking into account (A) any consideration received by the lessee in other related transactions, (B) the highest price paid for coal of like quality produced from the same general area during the lease month, (C) contracts or other business arrangements between coal producers and purchasers for the sale of coal other than coal produced under such lease, which are comparable in terms, volume, time of execution, area of supply and other circumstances, and (D) such other relevant factors as the Mining Supervisor may deem appropriate, and further provided that in cases where coal which was added to inventories and for which the gross value has been determined in accordance with this subsection is eventually sold, the Mining Supervisor may require the payment of such additional royalties, or allow such credits or refunds, as may be necessary to adjust the royalty payments to reflect the actual gross value of the coal.

§ 211.64 Weight basis for royalty computation.

(a) All bone coal, rock, and other impurities may be removed from the raw coal prior to determination of coal weights for royalty purposes.

(b) If royalties become due and payable prior to removal of bone coal, rock, and other impurities or final weighing of coal, the Mining Supervisor may determine, by estimate, the weight of the coal for royalty purposes. In addition, the Mining Supervisor may, after the removal of bone coal, rock, and other impurities and final weighing of the coal, require the payment of such additional royalties, or allow such credits or refunds, as may be necessary to adjust the royalty payments to reflect the true weight of the coal.

§ 211.65 Audits.

An audit of the accounts and books of lessees and permittees for the purpose of determining compliance with lease or permit terms relating to royalties may be required annually, or at other such times as may be directed by the Mining Supervisor, by a qualified independent certified public accountant or by an independent public accountant licensed prior to December 31, 1970, by a State, territory, or insular possession of the United States or by the District of Columbia, and at the expense of the lessee. The lessee shall furnish, free of cost, duplicate copies of audit reports which express opinions on such compliance to the Mining Supervisor within 30 days after the completion of each audit. Where such audits are required, the Mining Supervisor will specify the purpose and scope of the audit and the information which is to be verified or obtained.

§ 211.66 Maintenance of and access to records.

(a) Lessees and permittees shall maintain current and accurate records showing: (i) The type, quality or grade, and weight of all coal mined, sold, used on the premises, or otherwise disposed of, and all coal in storage (remaining in inventory); (ii) the prices received for all coal sold and to whom sold, by type and by quality or grade.

(b) The Mining Supervisor, or his designee, shall have access to all records of the lessees and permittees pertaining to compliance with lease or permit terms relating to royalties, including, but not limited to, (i) quantities mined, processed, sold, delivered, or used by the lessee; (ii) prices received for mined or processed products, prices paid for like or similar products, and internal transfer prices; and (iii) costs of mining, processing, and transportation.

(c) Licensees must maintain a current record of all coal mined and removed.

INSPECTION, ISSUANCE OF ORDERS, ENFORCEMENT OF ORDERS AND APPEALS

§ 211.70 Inspection.

The operator shall provide access and means at all reasonable times for the Mining Supervisor to inspect or investigate the operation to determine whether it is in compliance with all applicable laws, regulations, and orders; the terms and conditions of the lease, permit, or license; and the requirements of any approved plan.

§ 211.71 Notices and orders.

(a) *Address of responsible party.* Before beginning operations, the operator shall inform the Mining Supervisor, in writing, of the operator's temporary and permanent post office address and the name and post office address of the superintendent, or designated agent, who will be in charge of the operations and who will act as the local representative of the operator. Thereafter, the Mining Supervisor shall be informed of any change of such address.

(b) *Receipt of notices and orders.* The operator shall be construed to have received all notices and orders that are mailed by certified mail, return receipt requested, posted at the mine or mine office or handed to the superintendent, the mine foreman, the mine clerk, or higher officials connected with the mine or exploration site for transmittal to the operator or his local representative.

§ 211.72 Enforcement of orders.

(a) If the Mining Supervisor determines that an operator subject to the provisions of this Part has failed to comply with the regulations in this Part, other applicable Departmental regulations, the terms and conditions of the lease, permit, or license, the requirements of an approved plan, or orders of the Mining Supervisor and such noncompliance does not threaten immediate and serious damage of the environment, the mine or the deposit being mined, or other valuable mineral deposits or other resources, the Mining Supervisor shall serve a notice of noncompliance upon the operator by delivery in person to him or his agent or by certified or registered mail addressed to the operator at his last known address. Failure of the operator to take action in accordance with the notice of noncompliance within the time limits specified by the Mining Supervisor or to initiate an appeal pursuant to Part 290 of this Title shall be grounds for suspension of operations subject to such notice by the Mining Supervisor or his recommendations for the initiation of action for cancellation of the lease, permit, or license and forfeiture of any compliance bonds.

(b) The notice of noncompliance shall specify in what respect the operator has failed to comply with the provisions of applicable regulations, the terms and conditions of the lease, permit, or license, the requirements of an approved plan, or the orders of the Mining Supervisor, and shall specify the action which must be taken to correct such noncompliance and the time limits within which such action must be taken. A written report shall be submitted by the operator to the Mining Supervisor when such noncompliance has been corrected.

(c) If, in the judgment of the Mining Supervisor, an operator is conducting activities on lands subject to the provisions of this Part which fail to comply with the provisions of this Part the terms and conditions of the lease, permit, or license, the requirements of approved plans or the Mining Supervisor's orders, and which threaten immediate and serious damage to the environment, the mine or the deposit being mined, or other valuable ore-bearing mineral deposits or other resources, the Mining Supervisor shall order the immediate cessation of such activities, without prior notice of noncompliance. Such order may be appealed as provided in Part 290 of this Title. Compliance with such order shall not be suspended by reason of the taking of such an appeal, unless such suspension is ordered in writing by the official before whom such appeal is pending, and then only upon a determination by such official that such suspension will not be detrimental to the lessor or adversely affect the public interest, or upon submission of a bond deemed adequate to indemnify the lessor from any resulting loss or damage.

§ 211.73 Appeals.

Orders, determinations, decisions, and notices issued pursuant to the provisions of this Part may be appealed as provided in Part 290 of this Title.

§ 211.74 Variances.

(a) Variances from compliance with the performance standards set forth in this Part may be allowed as part of an approved mining plan under either of the following circumstances:

(1) Where an applicant states in a proposed plan or modification thereof that he cannot meet a performance standard specified in § 211.40(a) (2), (4), (6), (11), (12), or (13) of this Part, he may request a variance from such performance standard where such variance would be compatible with the approved post mining land use, and shall support his request with appropriate information demonstrating the need therefor The Mining Supervisor, after consultation with the appropriate authorized officer and the surface owner, if other than the United States, may approve or disapprove such variance, and shall advise the applicant and approve or disapprove the proposed plan or modification accordingly; or

(2) Where an applicant proposes a post mining land use that is substantially different from the land use immediately prior to exploration and mining, the Mining Supervisor, with the concurrence of the appropriate authorized officer and after consultation with the surface owner, if other than the United States, may approve a mining plan containing variances from the performance standards of 43 CFR 3041 and § 211.40(a) hereof, provided that:

(A) After consultation with the appropriate land use planning agencies, if any, the proposed development is deemed to constitute an equal or better economic or public use of the affected lands, as compared with the premining use.

(B) The granting of such variance is essential to achieving the proposed post mining land use.

(C) The applicant presents specific plans for the proposed post mining land use and appropriate assurances that such use will be:

(i) Compatible with adjacent land uses;

(ii) Supported by commitments and assured of investments from public agencies, where appropriate;

(iii) Practicable with respect to private financial capability for completion of the proposed development;

(iv) Planned pursuant to a schedule made part of the proposed mining plan so as to integrate the mining operations and reclamation with the post mining land use;

(v) Designed by qualified personnel in conformance with professional standards in order to assure the stability, drainage, and configuration necessary for the intended use of the site.

(D) To the degree possible, and taking into account the subjective nature of the assessment, the applicant has considered the impact of the proposed land use on the aesthetic character of the area by consulting with inhabitants of the area, and utilizing expertise in the landscape and geomorphologic fields.

(b) Any application for a variance pursuant to paragraph (a) of this Section shall demonstrate that any proposed disturbance of land above a highwall will facilitate compliance with the environmental protection and performance standards set forth in this Part.

(c) Any application for a variance pursuant to paragraph (a) of this section which proposes to place spoil or other material on the downslope below the bench in an area classed as "steep slope" shall demonstrate to the satisfaction of the Mining Supervisor that the permanent or temporary sediment loads in the receiving drainages and reclamation to the post mining land use will not have significant adverse effects upon the aesthetics of the area.

(d) All variances granted pursuant to this section shall be reviewed by the Mining Supervisor and the appropriate authorized officer not more than three years after granting of the variance and incorporation in the mining plan, to ensure that the operation is proceeding in accordance with the terms of the approved plan and the terms and conditions of any lease, permit, or license.

(e) An operator may apply for a variance pursuant to the provisions of paragraph (a) of this section only by submitting a new or revised mining plan to the Mining Supervisor pursuant to the provisions of this Part. Minor changes of operations which do not involve violations of the performance standards set forth in this Part, and the granting of a variance pursuant to § 211.40(a)(2) of this Part, will not be deemed to be subject to or require compliance with, the provisions of this section.

(f) If the Director determines that a decision to grant a variance would constitute a major Federal action significantly affecting the quality of the human environment, and that an environmental impact statement, as required by section 102(2)(C) of the National Environmental Policy Act, has not been prepared with respect thereto, such a statement shall be prepared. If the Mining Supervisor grants a variance to this section, he shall notify the appropriate land managing agency or land use planning agency for the purpose of determining whether any changes may, as a result of such variance, be required in any Management Framework Plan or equivalent land use plan.

§ 211.75 Applicability of State law.

(a) On the effective date of this Part, and from time to time thereafter, the Secretary shall direct a prompt review of State laws and regulations in effect or adopted and due to come into effect, relating to reclamation of lands disturbed by surface mining of coal in each State in which Federal coal has been leased, permitted, or licensed. If, after such review, the Secretary determines that the requirements of the laws and regulations of any such State afford general protection of environmental quality and values at least as stringent as would occur under exclusive application of this Part, he shall, by rulemaking, direct that the requirements of such State laws and regulations thereafter be applied as conditions upon the approval of any proposed exploration or mining plan, unless (i) the Secretary determines that such application of the requirements of such laws and regulations would unreasonably and substantially prevent the mining of Federal coal in such State, and (ii) the Secretary determines that it is in the overriding national interest that such coal be produced without such application of such requirements. In any such determination of overriding national interest, the Secretary will consult in advance of such determination with the Governor of the State involved.

(b) On the effective date of this Part, the Secretary will direct representatives of the Department to consult with appropriate representatives of each State or a number of States for the purpose of formulating and entering into agreements to provide for a joint Federal-State program with respect to surface coal mining reclamation operations for administrative and enforcement purposes. Such agreements shall, wherever possible, provide for State administration and enforcement of such programs, provided that Federal interests are protected. Any such agreement shall be entered into by rulemaking, and shall have as its principal purpose the avoiding of quality of administration and enforcement of reclamation laws governing surface coal mine reclamation operations.

PART 216 [RESERVED]

Part 216 of Chapter II of this Title 30 of the Code of Federal Regulations is revoked.

Title 43—Public Lands: Interior

SUBTITLE A—OFFICE OF THE SECRETARY OF THE INTERIOR

PART 23—SURFACE EXPLORATION MINING AND RECLAMATION OF LANDS

§ 23.2 [Amended]

Section 23.2(b) of Part 23 of Title 43 of the Code of Federal Regulations is amended by the deletion of the period and the addition at the end thereof of the following language: "; nor minerals or operations subject to the provisions of 43 CFR Subpart 3041."

Dated: May 11, 1976.

THOMAS S. KLEPPE,
Secretary of the Interior.

[FR Doc.76-14285 Filed 5-14-76;8:45 am]

Reclamation

Past and Current Reclamation

Past Reclamation

The first formal restoration of surface mined lands in northwestern Colorado began in 1965. On April 16, 1965, a voluntary memorandum of understanding was agreed to by the Colorado Department of Natural Resources and officials of the major coal mining companies operating in the State. The memorandum was signed by R. T. Eckles, coordinator for Colorado's Department of Natural Resources, who was administering the reclamation program, and by representatives of Energy Coal Company, Peabody Coal Company, and The Pittsburg and Midway Coal Mining Company. The Memorandum of Understanding, the first voluntary agreement with respect to reclamation entered into by any State, focused national attention on Colorado.

During 1965, the same year the agreement was signed, 538 acres of Colorado land were rehabilitated by the coal companies (Table RII-1). This represented more than half of the total land area affected by surface mining since its inception in the State in 1946. In 1966, 31 acres were seeded, and a total of 5,325 trees and shrub seedlings were planted. In 1967, nine species of grasses and legumes totaling 9,520 pounds of seed were planted on 476 acres, and 32 species of trees and shrubs totaling 7,100 seedlings were transplanted; however, the location and numbers of each species are unknown. In 1968, 311 acres were seeded and an unknown number of tree and shrub seedlings transplanted; all seed was broadcast aerially, and seedlings were transplanted by hand. Most of the spoils were graded before seeding; this consisted of flattening the ridgetops to a width of approximately fifteen feet, leaving the effects of mining still very evident (Figure RII-1).

Since very poor records were kept of the locations and dates of seedings and transplanting, it is difficult to accurately assess the success of these efforts, especially the shrub and tree transplanting. Overall vegetation establishment on the spoils has been fair to good. Results vary from essentially no vegetation on very coarse-textured spoils on steep south- and west-facing slopes, to excellent stands on slopes with similar aspects containing more fines, and on north- and west-facing slopes with varying degrees of texture.

Alfalfa has been the outstanding species used in spoil revegetation in this area; it is an excellent soil stabilizer and grows on steep slopes and all exposures (Figure RII-2). In stands dominated by alfalfa, only the taller grasses, such as smooth brome and intermediate wheatgrass, have been able to compete and contribute to forage production.

Berg (1975) sampled Peabody's Seneca 1 Mine in 1970 and 1975 and found that, following the reclamation efforts of the late 1960s (Table RII-1), alfalfa dominated for at least 10 years (Table RII-2). The apparent reason for these results is the nitrogen (N) fixing ability of alfalfa, as the spoils are very N-deficient, and its ability to root

TABLE II-1

Historical Reclamation Efforts

Rehabilitation efforts completed on northwestern Colorado's surface mined land as the result of a cooperative agreement between the Colorado Department of Natural Resources and the following companies: Energy Coal Company, Peabody Coal Company and The Pittsburg and Midway Coal Mining Company.

1965

Seeding[1]

Edna Mine	136 acres
Energy Mine	132 acres
Osage Mine	200 acres
Seneca Mine	70 acres
Total	538 acres

1966

Seeding[2]

Edna Mine	1 acre
Energy Mine	18 acres
Seneca Mine	12 acres
Total	31 acres

Shrub and Tree Transplanting[3]

Edna Mine	150 seedlings
Energy Mine	1,225 seedlings
Osage Mine	2,075 seedlings
Seneca Mine	1,875 seedlings
Total	5,325 seedlings

1967

Seeding[4]

Edna Mine	60 acres
Energy Mine	50 acres
Osage Mine	276 acres
Seneca Mine	90 acres
Total	476 acres

Shrub and Tree Transplanting[5]

7,100 seedlings
Location of transplanting unknown.

1968

Seeding[6]

Edna Mine	100 acres
Energy Mine	92 acres
Seneca Mine	119 acres
Total	311 acres

Shrub and Tree Transplanting[7]

The location and numbers of seedlings transplanted is unknown.

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[1] The seeding mixture consisted of the following:

Intermediate Wheatgrass	5 Lbs./Acre
Pubescent Wheatgrass	4 Lbs./Acre
Smooth Brome	4 Lbs./Acre
Timothy	3 Lbs./Acre
Durar Hard Fescue	1 Lb. /Acre
Rhizoma Alfalfa	3 Lbs./Acre
Yellow Blossom Sweet Clover	2 Lbs./Acre
Alsike Clover	3 Lbs./Acre
Total	25 Lbs./Acre

[2] The seeding mixture was the same as the one used in 1965 except the amount of Timothy was reduced, resulting in a total mixture of 23 pounds/acre.

[3] Seedlings consisted of the following:

450	Austrian Pine	200	Golden Willow	100	Autumn Olive
700	Ponderosa Pine	200	Hackberry	200	Squaw Bush
200	Lodge Pole Pine	100	Sycamore	300	Buffalo Berry
1,450	Chinese Elm	50	Eastern Cottonwood	400	Russian Olive
200	Rocky Mountain Juniper	50	Silver Maple	200	Bladdersenna
225	Green Ash	300	Black Locust		

[4] The seeding mixture consisted of the following:

Crested Wheatgrass	2 Lbs./Acre
Western Wheatgrass	2 Lbs./Acre
Tall Fescue	2 Lbs./Acre
Orchardgrass	1 Lb. /Acre
Bromegrass	4 Lbs./Acre
Cody Alfalfa	4 Lbs./Acre
Rhizoma Alfalfa	2 Lbs./Acre
Yellow Blossom Sweet Clover	2 Lbs./Acre
White Blossom Sweet Clover	1 Lb. /Acre
Total	20 Lbs./Acre

[5] Seedlings consisted of the following species:

Blue Spruce
Lilac
Caragana
Plum
Chinese Elm
Ash
Sand Cherry
Golden Willow
Hackberry
Honey Locust
Austrian Pine
Lodgepole Pine
Ponderosa Pine
White Fir
Mountain Mahogany
European Black Alder
Service Berry
Narrowleaf Cottonwood
Scotch Pine
Douglas Fir
Quail Bush
Eastern Red Cedar
Rocky Mountain Juniper
Sage
Tamarix
Alianthus
Squaw Bush
Bladdersenna
European Sage
Black Locust
Buffaloberry
Russian Olive

[6] The seeding mixture was the same as 1967 except Timothy was substituted for Orchardgrass and Vernal alfalfa was substituted for Cody alfalfa.

[7] Seedlings used were the same as 1967, and the numbers of each species are unknown.

TABLE II-2

Frequency and Relative Productivity by Species on Seneca 1 Spoils 1/

Species	1970 Sampling		1975 Sampling	
	% Frequency 2/	% of Total Production	% Frequency 2/	% of Total Production
Alfalfa (Cody)	78.5	79.0	91	57.4
Alfalfa (Rhizoma)	78.5	79.0	91	57.4
Sweet Clover	23.5	7.0	0	T 3/
Alsike Clover	0.0	0.0	0	0
Smooth Brome	31.5	6.0	70	24.4
Timothy	5.0	0.2	2	T
Crested Wheatgrass	19.0	1.0	28	3.1
Intermediate Wheatgrass	15.0	2.4	31	12.6
Pubescent Wheatgrass	15.0	2.4	31	12.6
Orchardgrass	16.5	3.0	28	3.1
Tall Fescue	10.5	0.3	6	.1
Hard Fescue (Durar)	0.5	T	4	.1
Cheatgrass	2.0	0.3	10	.8
Russian Thistle	2.0	T	0	0
Unidentified Forbs	2.0	T	8	T
Canada Thistle 4/	1.5	T	2	.4
Big Sage 4/	0.5	T	0	0
Bluegrass 4/	0.0	0.0	3	T
Goatsbeard 4/	0.0	0.0	2	T
Vetch (*Vicia*) 4/	0.0	0.0	1	T
Phlox 4/	0.0	0.0	1	T
Artemisia dracunculus 4/	0.0	0.0	1	.5
Dandelion 4/	0.0	0.0	1	T
Yarrow 4/	0.0	0.0	3	T

1/From Berg, W. A., 1975. Changes over five years in the composition and herbage production of seedlings on strip-mine spoils in northwestern Colorado. Progress report. Total production was 1700 and 1830 lbs/acre dry weight in 1970 and 1975 respectively.

2/Percent of the time this species occurred within the 1/2 m^2 sampling area.

3/T = Trace.

4/Not seeded.

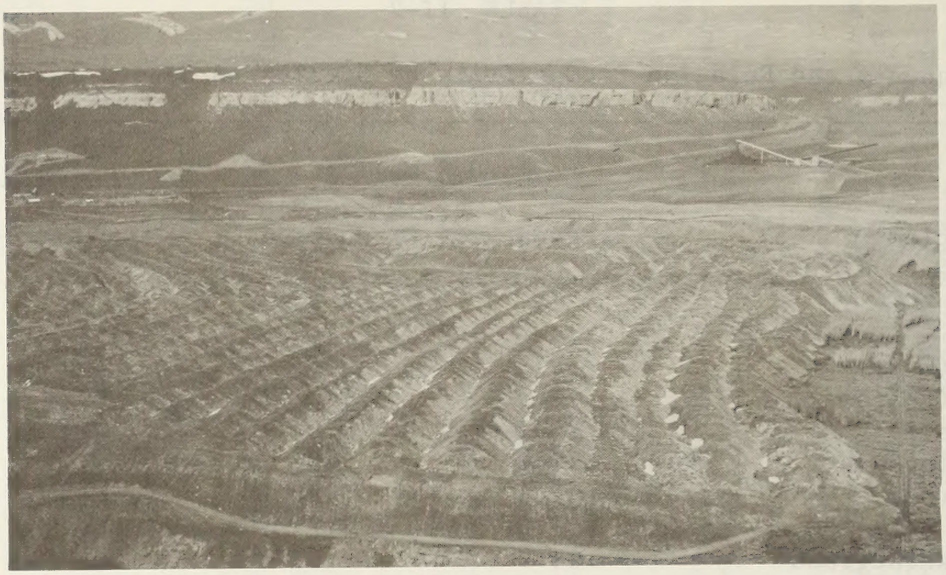

FIGURE II-1

The effects of strip mining are still very evident after early rehabilitation programs, Energy 1 Mine

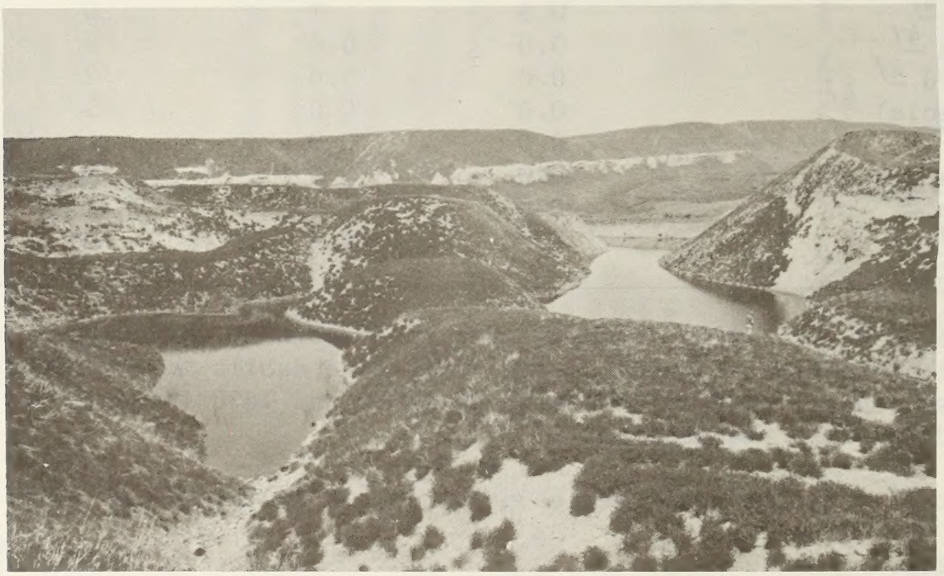

FIGURE II-2

Alfalfa has proven to be an excellent soil stabilizer on mine spoils on steep slopes and any exposure. Spoil material appears quite impermeable, as the two reservoirs pictured differ in elevation by approximately 10 feet, but are quite close; the water is of adequate quality to support fish (Peabody's Seneca 1 Mine).

deep and utilize the deep moisture in the loose spoils. The spoils sampled by Berg (1975) appear to be the most productive spoils in the region, partially because the area has been very lightly grazed since reseeding. Herbage production averaged 1700 pounds dry weight/acre in 1970, and 1830 pounds in 1975. The difference is not believed to be significant, but the differences in composition probably are (Berg 1975). The reduction in dry matter produced by alfalfa was offset in overall productivity by increases in dry matter produced by smooth brome and wheatgrasses. Soil cover by living and dead vegetation averaged 60 percent in 1970 and 77 percent in 1975; this increase is largely due to an increase in litter during the growing season in this area, because of the bloat hazard. Because of the steepness of the spoils and bloat problem, the usefulness of the vegetation produced is very limited.

Plantings of woody species in the late 1960s were not done in a systematic manner, and success was difficult to monitor. Initial establishment of deciduous species was fair to good; survival of conifers was poor to nil. Browsing by big game and sheep has severely retarded growth of the deciduous species. Russian olive and caragana are the species which now show the most vigor, probably because they are less palatable than the other species, and possibly because of their N-fixing ability. The initial growth of Hansen's rose and Chinese elm was outstanding, but these species have been particularly heavily browsed.

Competition for moisture between the woody and herbaceous species is obvious. Where deciduous woody plantings were made in areas with limited or no competition from herbaceous species, growth has been satisfactory (taking into account the heavy browsing). Growth of the woody species has been restricted in even moderate stands of herbaceous species. Very little invasion of native species has occurred on old mine spoils, indicating that raw overburden material may not be suitable for growth of native species. Past reclamation efforts have produced a plant growth medium that is very coarse, and holds very little moisture near the surface. Since the largest number of native plants on the areas to be mined (grasses and forbs) require moisture in the top three feet of soil, it is very likely that most of the native plant species are not adaptable to these areas until many years of soil development have taken place. On areas of abandoned croplands near the mining areas where native vegetation has been removed, but only the top 8-12 inches of soil disturbed, a number of native plants have shown an ability to re-establish in 5 to 10 years.

Past spoil grading has created numerous south and west facing slopes ,and many areas of very rocky spoil material. If these slopes had been reshaped to approximate premining contours, creating fewer harsh sites, the area could produce significantly more useful vegetation.

The effects of strip mining remain very evident after rehabilitation efforts of the past; approximately 3,300 acres have been revegetated, but are not producing to the capacity possible, had more intensive reclamation efforts been utilized.

Current Reclamation

The most significant advancement of current restoration practices is the development of a reclamation plan before mining and reshaping of the spoils to approximate original contours (Figures RII-3 and RII-4).

At Pittsburg and Midway's Edna Mine, spoils are regraded to approximate original contours and seeded to the following species with a rangeland drill: manchar smooth brome, nordan crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, hard fescue, Russian wildrye, and yellow sweet clover. Alfalfa has been eliminated from the mixture because of bloat problems with domestic livestock. Current reclamation procedures at Edna Mine have not been utilized for a long enough period of time to predict success. Pittsburg and Midway will utilize results of test plots of grasses and shrubs, planted on their spoils by the U.S. Soil Conservation Service, to continually upgrade their seeding mixture.

In addition to reshaping to approximate original contours, Energy Fuels is also removing topsoil before overburden removal to replace on shaped spoils (Figures RII-5 and RII-6), and plans to return part of their mined lands to cropland.

Energy Fuels is returning topsoil to a depth of approximately 18 inches on areas reclaimed for cropland, and eight inches on areas reclaimed for grazing land. The current seed mixture on grazing land areas is smooth brome, orchard grass, intermediate wheatgrass, and alfalfa. Cropland areas will be primarily seeded to small grains.

Energy Fuels is also rehabilitating the spoils from the old mining operation by leveling and reshaping the spoils to approximate original contour, replacing topsoil to a depth of four-six inches where available, and reseeding.

Energy Fuels' current reclamation program has only been implemented recently; therefore, the success is not yet known. However, topsoil replacement should greatly increase reclamation potential, if the replaced topsoil is protected from erosion. A small area, approximately two acres, was topsoiled and seeded two years ago; the most obvious difference that topsoil has provided is the invasion of the following native species: mullen, yarrow, larkspur, big sagebrush, penstemon, dandelion, and wild onion.

Peabody's reclamation program is much like their old program except for new grading procedures (Figure RII-4). The following seed mixture is aerially seeded in the spring: vernal alfalfa, rhizoma alfalfa, yellow sweet clover, crested wheatgrass, intermediate wheatgrass, western wheatgrass, smooth brome, tall fescue, and timothy. No areas returned to approximate original contours have been revegetated, but some areas that have been extensively graded and revegetated produce a relatively good vegetative cover that is dominated by alfalfa.

The following species are included in the Soil Conservation

Service test plots at the Pittsburg and Midway Mine.

Seeded Species	Accession
Western wheatgrass	Arriba
James penstemon	NM-724
Western wheatgrass	Rosana
Palmer penstemon	NM-618
Western wheatgrass	P-727
Rocky Mountain penstemon	Bandera
Thickspike wheatgrass	Critana
Alfalfa	
Streambank wheatgrass	Sodar
Indian ricegrass	Paloma
Great Basin wildrye	C-43
Fourwing saltbush	P-15585
Russian wildrye	Vinall
Crownvetch coronilla	Chemung
Hard sheep fescue	Durar
Yellow sweet clover	

Transplanted Species	Accession
Russian olive	Wy 292A
Oregon grape	NM 1095
Rose	NM 1081
Winterberry (euonymus)	Pink lady
Russian olive	NM 476
Cliffrose	NM 624
Rose	NM 1070
Skunkbush sumac	Wyo 843
Rose	NM 1043
Mountain mahogany	NM 715
Silver buffaloberry	NM 1163
Woods rose	NM 1068
Antelope bitterbrush	NM 503

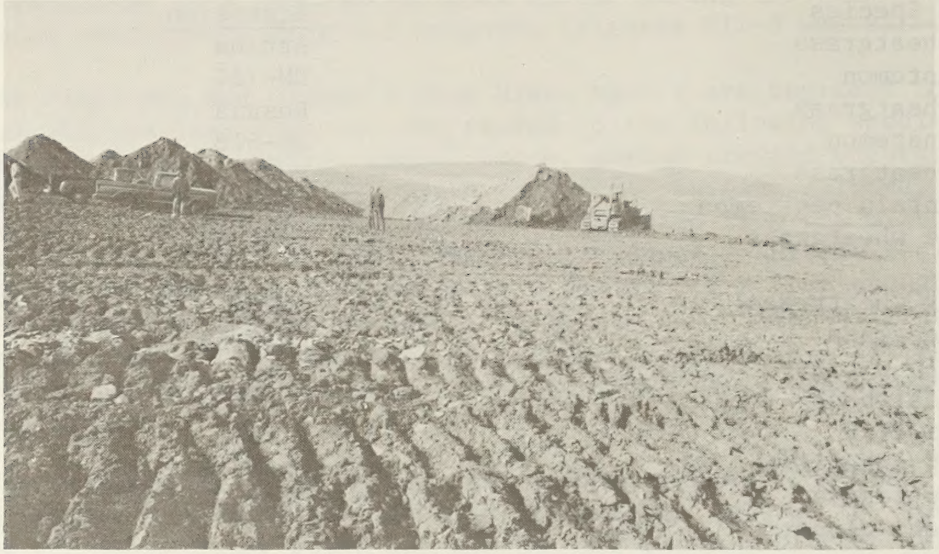

FIGURE II-3

Current grading procedures at Pittsburg and Midway's Edna Mine. Grading is begun after three rows of spoils is produced. Foreground has been seeded with a rangeland drill.

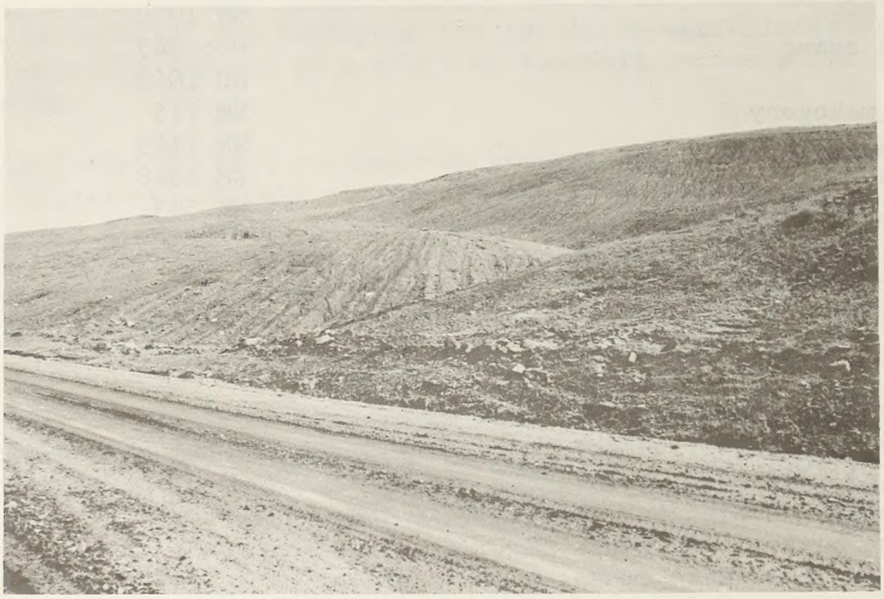

FIGURE II-4

Surface configuration after grading at Peabody's current Seneca 2 Mine.

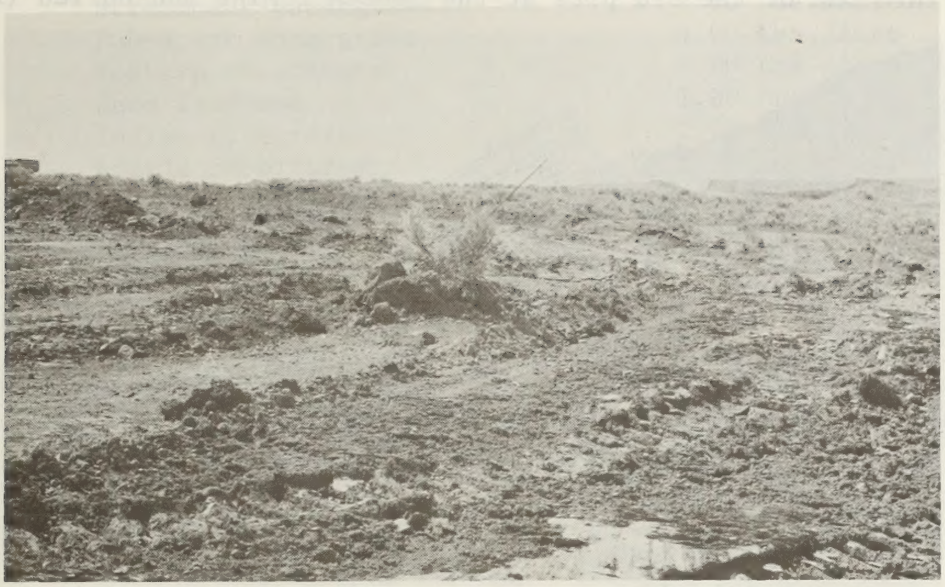

FIGURE II-5

Topsoil has been removed from this area prior to mining for replacement on reshaped spoils, Energy 2 Mine.

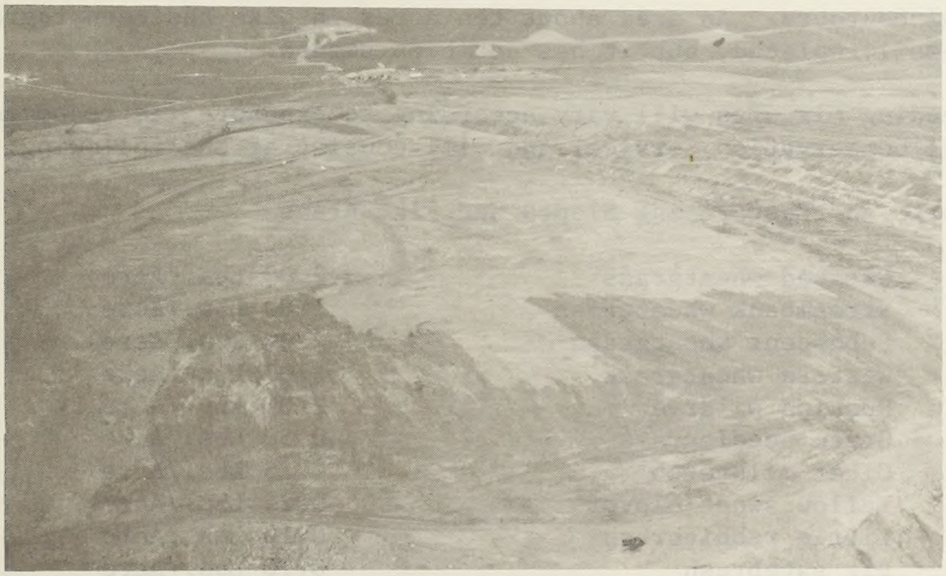

FIGURE II-6

Dark area is where topsoil has been replaced after reshaping, Energy 1 Mine.

Peabody plans to create a lake in the cut at the bottom of the slope at the current Seneca 2 Mine. Also, fly ash from the Hayden power plant is dumped into one of the old pits at the Seneca 2 Mine and buried (Figure RII-7).

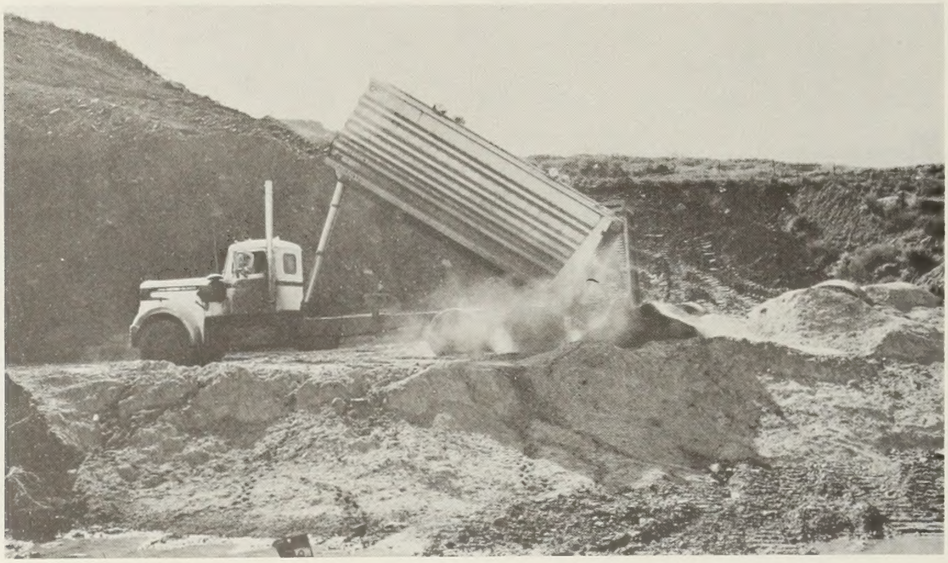

FIGURE II-7

Fly ash from the Hayden power plant is dumped into an old pit at Peabody's Seneca 2 Mine and buried.

Empire Energy opened a surface mine April 1975; since this mine is relatively new, only a small part of their reclamation plan has been implemented. They are removing topsoil before mining, and will replace it to a depth of twelve inches, after regrading the spoils to the approximate original contours. An area about ten acres in size has been regraded and topsoil replaced, but it has not been seeded.

Seeding mixtures will vary according to exposure (as recommended by the Soil Conservation Service) and will consist of the following:

North and East Facing Slopes and Flat Areas

Crested wheatgrass	2.00 Lbs./Acre
Streambank wheatgrass	1.00 Lbs./Acre
Pubescent wheatgrass	2.00 Lbs./Acre
Western wheatgrass	2.00 Lbs./Acre
Russian wildrye	2.00 Lbs./Acre
Green needlegrass	0.50 Lbs./Acre
Cicer milkvetch	0.25 Lbs./Acre
Yellow sweet clover	0.25 Lbs./Acre
Little rabbitbrush	0.10 Lbs./Acre
Big sagebrush	0.10 Lbs./Acre
Antelope bitterbrush	0.50 Lbs./Acre
	10.70 Lbs./Acre

West, South, Northwest, and Southwest Facing Slopes

Streambank wheatgrass	4.00 Lbs./Acre
Pubescent wheatgrass	4.00 Lbs./Acre
Western wheatgrass	4.00 Lbs./Acre
Sand dropseed	1.00 Lbs./Acre
Indian ricegrass	2.00 Lbs./Acre
Little rabbitbrush	0.25 Lbs./Acre
Big sagebrush	0.25 Lbs./Acre
	15.50 Lbs./Acre

Current reclamation practices of existing mines do not alleviate the effects of strip mining, but the companies are returning mined lands to a state with much higher potential and less obvious topographic differences than former rehabilitation efforts achieved.

Geologic and Geographic Setting

APPENDIX D

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FOR
GEOLOGIC AND GEOGRAPHIC SETTING

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TABLE III-1

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)1	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (rank)	Oil( ) Gas( )	Other
Quaternary	Qal	Alluvium, including low terrace deposits.			Silt, sand and gravel; some clay; moderately sorted and bedded		River and other stream valleys.			Sand and gravel. Placer gold locally.
	Qx	High terrace and morainal deposits, talus rockfalls, collurium.			Sand, gravel; angular and unsorted materials; some silt and clay.		High terrace remnants along some streams and elsewhere; Talus and rockfalls along steep hills or cliffs.			Sand and gravel. Placer gold locally.
Tertiary										
Pliocene	Tv	Volcanic flows, plugs; intrusive dikes, sills, stocks.	--	Flows: Sills:	Basalt	Landslide potential where underlain by soft strata on steep slopes.	White River Uplift and scattered occurrences north to Elkhead Mts. and to Wyoming.			
Miocene	Tbp	Browns Park Formation.	--	2,200	Typically sandy conglomerate or gravel overlain by white fine-to coarse- grained partly tuffaceous sandstone or sand.	Very susceptible to landsliding where overlain by hard layers; subject to earth flows on steep slopes.	From near Craig west to Green River between prongs of Uinta Mts.; Elkhead Mts.; southern Routt County.			Uranium in Maybell-Lay area.
Miocene or Oligocene	Tbe	Bishop Conglomerate.	--	0-100	Coarse gravel or conglomerate.		On very high-surfaces in Uinta Mts.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (rank)	Oil( ) Gas( )	Other
Late Triassic		Popo Agie Formation	Equivalent to part of Chinle Formation to south and west.	0-120	Pale red to purplish red sandy siltstone overlain by claystone.		Present only near Hahns Peak and Clark, north of Steamboat Springs.			
		Jelm Formation	Equivalent to part of Chinle Formation to south and west.	0-100	Sandstone, fine-grained, micaceous, grayish-red and reddish-brown and purple; massive bedded.	Makes rounded ledges.	Present only near Hahns Peak and Clark, north of Steamboat Springs.			
Early Triassic		Moenkopi Formation	Partly equivalent to State Bridge Formation.	480-800	Grayish-green and red siltstone, shale and fine-grained sandstone; partly gypsiferous; few thin beds of limestone.	Forms slopes. Similar to Dinwoody in engineering characteristics.	Uinta Mts. area. Conspicuous alteration in Skull Creek area.			In Skull Creek area high metal content locally: V, Cr, Cu, Ni, Co, Ag, La, B, Hg.
Early Triassic		Dinwoody Formation		0-300±	Shale, sandy shale, thin sandstone beds. Light gray.	Non-resistant. Underlies low areas and forms soft rounded outcrops; moderately high natural stability but bearing strength not high.	Only in northwest corner of Moffat Co. Supports little vegetation.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Notable Occurrences	Deposits of Economic Interest: Coal (rank)	Deposits of Economic Interest: Oil( ) Gas( )	Deposits of Economic Interest: Other
Late Jurassic	Jm	Sundance Formation	(Equivalent to Curtis, Entrada and Carmel)	0-260	Gray very fine grained sandstone; greenish gray shale; glauconitic sandstone and siltstone.	Sandstone forms cliffs and ledges; shale forms slopes.	Present only in eastern part of area.			
Early Jurassic and Late Triassic		Glen Canyon Sandstone	Navajo Sandstone Nugget Sandstone	0-540	Sandstone, fine-to-medium-grained thick-bedded; high cross-beds; gray to red.	Prominent cliff-forming sandstone in Uinta Mts.; forms high bare dome-shaped buttes (Cadigan)	Uinta Mts.; Skull Creek area. Has some four-toed dinosaur tracks.			
Late Triassic	Trc	Chinle Formation	Poyo Agie Formation. Jelm Formation. Chugwater Formation.	127-565	Red-siltstone claystone, sandstone; limestone-pellet conglomerate and some limestone.	Poor outcrops but mostly well indurated and should stand well in steep cuts.	Uinta Mts. have best exposures. Reptile fossils.			
		Gartra Member of Chinle Formation	(Formerly Shinarump Conglomerate)	0-250 Abruptly variable.	Poorly sorted sandstone and conglomerate. Pale lavender to grayish pink. Massive to cross-bedded.	Blocky outcrops; contributes large boulders on steep slopes.				Small uranium deposits near Skull Creek
		Nugget Sandstone (Bell Springs Member)	Equivalent to part of Chinle Formation to south and west.	0-50	Reddish-brown very fine grained thin-bedded sandstone and reddish brown siltstone; purplish limestone concretionary beds.	Weathers to slabby or rounded ledges and slopes.	Present only near Hahns Peak and Clark, north of Steamboat Springs.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Notable Occurrences	Deposits of Economic Interest: Coal (rank)	Deposits of Economic Interest: Oil( ) Gas( )	Deposits of Economic Interest: Other
Late Jurassic	Jm	Morrison Formation	--	440-800 486 at Juniper Mtn.	Variegated soft bentonitic shales and mudstones; medium-to-coarse grained sandstones; chert, pebble conglomerate.	Mudstones are plastic when wet and thus unstable. Landslides observed.	Fossil dinosaur bones at Dinosaur National Monument.		Gas shows	
		Curtis	Upper Sundance of Wyoming; Stump Fm. of northern Utah.	0-260 45 at Juniper Mtn.	Sandstone, shale and thin-bedded limestone; gray to greenish gray. Glauconitic. Marine origin.	Varies because of variable lithology. Moderate to high slope stability and bearing strength.	Especially Uinta Mts. and Juniper Mt. Marine fossils common.			Copper-uranium vandium deposit near Skull Creek.
		Entrada	Sundance Fm. to northeast. Preuss sandstone to northwest.	22-360	Sandstone, fine-to-medium grained, buff-to light gray. Locally has siliceous cement. Some red or brown mudstone.	Generally forms cliffs or steep slopes. Relatively resistant and stable.	Juniper Mt. and Uinta Mts. especially. Generally has good porosity and thus excellent aquifer.			
		Carmel	Basal part of San Rafael Group in Utah.	0-125	Sandstone, silty; shale and siltstone; reddish brown; some gypsum. Marine origin.	Form slopes mostly; unstable at relatively low slope angles. Some landslides and slumps observed.	Only in Uinta Mts. Pinches out eastward. Some dinosaur tracks.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)1	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest: Coal (rank)	Deposits of Economic Interest: Oil( ) Gas( )	Deposits of Economic Interest: Other
Upper Cambrian	El	Lodore Formation	Sawatch Quartzite	0-400	Sandstone, white, topped, quartzite, partly arkosic, with some silty shale interbedded.	Forms nearly vertical cliffs.	In Uinta Mts. area, Cross Mts. and Juniper Mtn.			
Precambrian	PE	(Unnamed)	--	(Thousands)	Granitic and mafic intrusive rocks; gneiss, schist and other metamorphic rocks.	Mostly quite resistant to erosion, forms steep high mountain slopes.	Forms the high Park, Gore, and Sierra Madre Ranges along east east side of area.			Uranium minerals near Steamboat Springs.
		Uinta Mountain Group		24,000±	Mostly red to white, medium to coarse-grained, quartzitic, partly arkosic, massive to cross-bedded sandstones; some conglomerate.	Forms bold rugged outcrops and sheer cliffs. Resistant to erosion, great strength. Brittle, but stable foundations.	Eastern Uinta Mts.; Cross and Juniper Mts.			
		Red Creek Quartzite	--	20,000±	Metaquartzite, amphibolite, and mica schist.	Very hard but brittle, Great bearing strength stable except some mica schist zones.	Only in small part of northeastern Uinta Mts., where it forms all high peaks.			Barite, copper, and uranium occurrences

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)1	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (Rank)	Oil( ) Gas( )	Other
Upper Devonian	MDE	Chaffee Group		0-225±	Dolomite and limestone, partly oolitic; cherty; some green shale, quartzite.	Lower part forms slope. Upper part forms cliffs and slopes and has solution cavities 0.3-1.5 feet in diameter.	White River Uplift and southern Routt Co. Possibly, 20-30 feet of dolomite at base of Madison at Cross and Juniper Mts.			
Lower Ordovician	MDE	Manitou Formation		0-155	Upper half thin-bedded siliceous dolomite; lower half interbedded flat-pebble conglomerate and limy shale.	Upper half forms steep cliff, lower half forms cliff or steep slope.	White River Uplift area and southeast Routt Co.			
Upper Cambrian	MDE	Dotsero Formation		0-106	Dolomite, brownish-gray, thin-bedded; flat-bedded limestone and dolomite-conglomerate; thin beds green-gray shale.	Forms steep slope between a cliff below and overlying slope and cliff.	White River Uplift area and southeast Routt Co.			
	Es	Sawatch Quartzite	Lodore Fm.	0-400±	Regularly bedded quartzite sandstone, sandstone and quartzite; some dolomite and shale.	Very resistant, forms steep cliffs.	Only in southern Routt Co. and White River Uplift area.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (rank)	Oil( ) Gas( )	Other
Pennsylvanian	Pm	Morgan Formation	Equivalent to most of Minturn Minturn Formation	0-1,280 1,019 at Juniper Mtn.	Limestone, sandstone and variegated shale beds; dolomitic and nodular limestone.	Generally quite resistant to erosion except for shale beds.	Well developed at Juniper Mtn., where Yampa River cuts through more than 1,000 feet. Quite fossiliferous.			
		Minturn Formation	Equivalent to Morgan Formation	0-1,000+	Lenticular beds of arkosic conglomerate, shale and quartzite with some beds of dolomite and limestone.	Relatively resistant to erosion,forms cliffs and steep slopes.	Southern Routt Co.			
		Eagle Valley Formation		(Uncertain)	Gypsum or anhydrite and interbedded gray shale, siltstone and thin limestones.	Subject to diapiric and dissolution.	Only along White River 20 to 30 miles east of Meeker			
Mississippian	Mm	Madison Limestone	Equivalent to Leadville Limestone. Other Fms. in Utah	0-600 270 at Juniper Mtn.	Limestone and dolomite light to dark	Porous and cavernous; has many calcite-filled cavities; cliff-forming	Juniper Mtn. Eastern Uinta Mts. and Cross Mt. Caverns in Green River canyons.			
	MDE	Leadville Limestone	Equivalent to Madison Limestone	0-200+	Mostly limestone. Lower half has dolomite and dark gray chert. Upper half oolitic limestone.	Forms light-gray cliffs capping steep slopes.	White River Uplift.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest: Coal (rank)	Deposits of Economic Interest: Oil( ) Gas( )	Deposits of Economic Interest: Other
Triassic and Permian		State Bridge Formation	Partly equivalent to Moenkopi and Park City Formations.	0-500	Red and gray siltstone and shale; some sandstone.		Southern Routt Co.			
Permian		Park City Formation	Khsphoria Formation	50-290	Gray, yellow and red siltstone and shale; thin-bedded limestone and dolomite; sandstone; some phosphate, chert.	Limestone predominates in places and makes long resistant hill slopes.	Uinta Mts.			Phosphate rock, especially in Utah.
Permian and Pennsylvanian	Pw	Weber Sandstone	Equivalent to Maroon and upper part of Minturn Fm.	0-1,000±	Sandstone, fine-grained, cross-bedded, thick-bedded, gray to white and buff.	Form steep-walled canyons and rocky tree-covered slopes.	Uinta Mts., especially canyon of Yampa River.			Small uranium deposit near Skull Creek.
		Maroon Formation	Partly equivalent to Morgan and Weber Fms.	0-2,000±	Red, yellow and brown mudstone, sandstone, arkose, and conglomerate with some beds of gypsum and thin limestone.	Very susceptible to landslides, mudflows, slumps.	Southern Routt Co.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)1	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (rank)	Oil( ) Gas( )	Other
	Kmv	Mesaverde Group, undivided		2,750 - (east) 2,500 - (Rangeley)	Thick beds of light brown sandstone and some thick key beds of white sandstone interbedded with gray shale, sandy shale, and coal beds.	(See Iles and Williams Fork Formations)	Rangely and Uinta Mts. region.	Bituminous		
	Km	Mancos Shale	Hilliard Shale in Wyoming north of Uinta Mts.	4,900± - Bass 5,300 - Rangeley	Dark gray marine shale; several thin-bedded silty tan sandstone beds in upper 1,000 feet.	Forms low rolling plains between more resistant formations. Susceptible to landsliding and slumping. Sandstone beds in upper part form low ridges and cliffs.	In broad southwestward-trending belt along Williams Fork, and in large area northwest of Steamboat Springs.		Gas shows	
		Niobrara Formation	(Mapped with Mancos Shale)	± 1,300 (600-700 ?	Limy shale interbedded with thin beds of platy fossiliferous limestone.	Weathers into very light gray limestone chips. More resistant than adjacent shale beds.	In Williams Park, just above Frontier. Four miles NE of Phippsburg.		Gas shows	
		Frontier Sandstone	(Same)	50± - (east) 150± - (west)	Thin-bedded, fine-grained fossiliferous limy sandstone.	Moderately high stability except where dip is steep. Stable foundation.	In Williams Park, about 330 ft. above base of Mancos. Uinta Mts. area.		Gas shows	
		Mowry Shale	(Same) Equivalent to basal part of Mancos	50-200	Marine shale, light to dark gray, but weathers distinctive silvery-gray. Hard, siliceous.	Weathers to chips and small fragments. Probably moderately high slope stability except on dip slopes.	Uinta Mts. mostly. Fish scales are diagnostic.		Oil shows	
Lower Cretaceous	Kd	Dakota Sandstone	Fuson Shale Lakota Sandstone	90-165	Sandstone, fine to coarse grained, hard, partly conglomerate some light to dark gray shale beds.	Generally forms massive ridge. Excellent for foundations except shale parts.	Water gap of Yampa River at Steamboat Springs.			Uranium minerals northeast of Meeker.

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (rank)	Oil( ) Gas( )	Other
Upper Cretaceous	Kls	Lewis Shale	Steel Shale	0-1,900 $\pm$ 1,900 (central)	Dark gray to bluish marine shale; some large calcareous concretions; interfingers with Mesaverde increasingly westward.	Forms low rolling generally treeless country between more resistant formations. Very susceptible to slumping and landsliding; weathers pale yellow.	From near Lay east through Craig area, past Hayden southeast to Twentymile Park and Oak Creek; north from Hayden into Elkhead Mts. Not present south of Axial Basin.			
	Kwf	Williams Fork Formation of Mesaverde Group	Mesaverde Group	1,100 - (east) 1,700 - (central) 2,000 $\pm$ - (west)	Shale, thin and a few thick sandstone beds, sandy shale, and several coal beds. Thick Twentymile Sandstone Member near top. Red burned and baked areas common.	Generally forms slightly less rugged hills than Iles. Twentymile Sandstone Member forms conspicuous cliffs. Relatively stable.	Forms bulk of Williams Fork Mts. and much of Danforth Hills.	Bituminous (some in upper part is subbituminous)		
	Ki	Iles Formation of Mesaverde Group	Mesaverde Group	1,500 - (east) 1,370 - (central)	Massive to slabby sandstone beds, light gray to brown and interbedded shale, siltstone and coal beds Trout Creek (top) and Tow Creek (base) Sandstone Members.	Generally forms rugged hills with numerous ledges and cliffs. Trout Creek Sandstone forms very conspicuous cliffs. Relatively stable.	Excellent exposures on Iles and Duffy Mts., Williams Fork Canyon, south slopes Williams Fork Mts. and Danforth Hills.	Bituminous		

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest: Coal (rank)	Deposits of Economic Interest: Oil( ) Gas( )	Deposits of Economic Interest: Other
Paleocene	Tfw	Fort Union Formation	Post-"Laramie" Formation (1924 report)	2,500 - (Powder Wash) 1,400 - (Craig) 1,675 - (west of Meeker)	Interbedded brown medium-to-coarse-grained sandstone, and coal beds; some of them quite thick; ferruginous layers.	Beds mostly poorly consolidated except for numerous ferruginous layers.	Brown and gray sandstone and shale with coal beds; thick sandstone beds in lower part.	Subbituminous		
	Toc	Ohio Creek Formation		0-50±	Light-brown to white sandstone, locally quartzitic, locally has chert pebbles or conglomerate.	Moderately resistant.	Known only in small areas, mostly near Strawberry Creek west of Meeker.			
Upper Cretaceous	Kl	Lance Formation	"Laramie" Formation (1924 and some older reports).	0-1,500	Interbedded gray shale, light tan soft finer-grained sandstone and a few coal beds, some quite thick. Thick coarse-grained white sandstone at top.	Beds mostly poorly consolidated.	From 4 miles north of Lay, in narrow belt eastward to just north to Elkhead Mts., also near Slater at State boundary.	Subbituminous	Gas shows	
		Fox Hills Sandstone	(Mapped with overlying Lance Formation)	0-50±	Sandstone, medium-grained, massive, white to gray.	Forms steep slope or cliff above soft Lewis Shale and below soft Lance beds.	Forms rim rock ½ mile north of Craig.			

TABLE III-1 (Cont.)

Geologic Formations of Northwest Colorado

Age	Map Symbol	Formation Name or Deposit	Former Name or Correlative in Adjacent Areas	Thickness (feet)[1]	Lithology	Possible Engineering Hazards or Outcrop Characteristics	Outcrop Areas or Notable Occurrences	Deposits of Economic Interest		
								Coal (rank)	Oil( ) Gas( )	Other
Eocene	Tu	Uinta Formation	Washakie Formation in Wyoming	0-360	Sandstone, brown to gray, medium to coarse-grained, interbedded with gray and brown calcareous shale.		Small area near Rangely.			
	Tb	Bridger Formation	Washakie Formation in Wyoming	0-375+	Tuffaceous claystone, lavender crossbedded sandstone, and gray cogwinal limestone.		Western Sand Wash Basin.			Zeolite (Clinoptilolite)
	Tg	Green River Formation	(Several members)	0-2,100±	Shale, oil shale, sandstone, and some limestone.		Western Sand Wash Basin. Also Gray Hills northwest of Meeker.			Oil shale, Sodium zeolite (analclime). Placer gold.
	Tw	Wasatch Formation	(Several members)	0-6,750±	Mostly medium to very coarse-grained conglomeratic sandstone interbedded with gray and red clays and mudstones. Local coal beds near Hiawatha only.	Mostly poorly consolidated.	Sand Wash Basin. Also Coyote Basin northwest of Meeker.	Subbituminous		Bituminous sandstone. Placer gold

Coal Production

APPENDIX D

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FOR
COAL PRODUCTION

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Coal Production

TABLE IV-1

Coal Produced (Short Tons) in Northwest Colorado From 1887 to Jan. 1, 1975

	Counties		
Year	Moffat	Rio Blanco	Routt
1887	---	---	---
1888	---	---	---
1889	---	2,900	1,491
1890	---	200	705
1891	---	---	---
1892	---	100	330
1893	---	---	816
1894	---	1,680	2,710
1895	---	1,761	2,767
1896	---	1,400	1,832
1897	---	1,882	945
1898	---	1,311	1,339
1899	---	--- 1/	1,211
1900	---	3,911 6/	1,375
1901	---	--- 1/	1,558
1902	---	--- 1/	3,180
1903	---	--- 1/	2,775
1904	---	---	5,568
1905	---	---	3,643
1906	---	--- 1/	5,297
1907	---	--- 1/	5,690
1908	---	--- 1/	13,005
1909	---	--- 1/	92,430
1910	---	--- 1/	258,452
1911	---	--- 1/	317,791
1912	---	--- 1/	448,261
1913	---	---	334,961
1914	---	--- 1/	666,384
1915	---	--- 1/	852,315
1916	---	--- 1/	915,028
1917	---	--- 1/	1,074,103
1918	---	1/	914,300

1/ Production summed with other counties

6/ Includes Jefferson County

Coal Production

TABLE IV-1 (Cont.)

Year	Counties Moffat	 Rio Blanco	 Routt
1919	---	--- 1/	1,181,332
1920	---	6,472 3/	964,342
1921	---	--- 1/	880,015
1922	4,875	3,349	432,198
1923	--- 1/	3,706	803,455
1924	6,963	3,188	911,643
1925	7,188	6,264	1,009,703
1926	4,950	--- 1/	920,569
1927	3,913	4,598	925,633
1928	4,896	5,165	929,190
1929	5,853	5,977	1,006,157
1930	7,637	5,599	838,828
1931	5,147	6,931	570,886
1932	3,798	5,323	572,458
1933	2,606	4,264	467,551
1934	2,945	3,937	485,311
1935	6,804	4,518	789,905
1936	6,871	5,206	987,338
1937	18,229	4,320	1,024,621
1938	35,205	4,254	741,431
1939	55,900	--- 1/	727,440
1940	48,162	--- 1/	909,942
1941	49,459	57,358 4/	878,952
1942	65,817	15,064 5/	1,231,608 4/
1943	100,689 2/	50,869 4/	1,194,483
1944	138,394	54,497 4/	1,187,237
1945	128,594	40,796 4/	1,093,294
1946	142,023	11,927 4/	896,303
1947	146,494	23,572 4/	1,016,823
1948	144,288	35,142 4/	939,875
1949	130,404	48,050 4/	807,289
1950	125,743	73,611 5/	832,928

1/ Production summed with other counties

2/ Includes Jackson County

3/ Includes Moffat County

4/ Includes Montrose County

5/ Includes Montezuma County

Coal Production

TABLE IV-1 (Cont.)

	Counties		
Year	Moffat	Rio Blanco	Routt
1951	110,275	40,190 5/	678,698
1952	90,590	40,402	688,486
1953	90,660	23,266	616,164
1954	85,683	18,539	450,146
1955	100,556	20,047	522,942
1956	96,461	18,728	484,034
1957	108,025	12,902	458,964
1958	117,855	11,250	386,635
1959	120,463	10,841	389,695
1960	125,805	11,841	469,325
1961	117,257	10,643	446,355
1962	128,381	8,296	488,105
1963	158,298	6,587	786,815
1964	175,472	7,217	899,175
1965	194,672	6,112	1,347,634
1966	194,142	5,331	1,557,789
1967	215,997	4,964	1,814,484
1968	347,714	5,536	1,737,474
1969	383,041	5,352	1,784,697
1970	468,488	3,354	1,990,535
1971	448,982	770	1,710,386
1972	295,873	4,556	2,231,085
1973	289,560	329	2,606,025
1974	240,751	11,766	3,457,899
Total:	6,109,749	797,594	63,128,613

Total 69,035,956

5/ Includes Montezuma County

Water Resources

APPENDIX D

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WATER RESOURCES

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APPENDIX D

Water Resources

Surface Water

Water Quality

Sediment Yield due to mining and associated activities is computed in the following three tables for the periods 1976-80, 1981-85, and 1986-90.

TABLE V-1

(Computations for Tables RV-2, RVI-1, RVII-1 Regional Analysis)

1976-80

Estimates and assumptions which were used to compute the total sediment yeild follow:

1) Surface mines:
4,825 x 1.7 x 2.7 = 22,100 tons
Where: 4,825 = Total acreage disturbed during 5-year period.
1.7 = Estimated sediment yield in acre-feet per square mile.
2.7 = Conversion factor to convert acre-feet per square mile to tons per acre.

2) Surface mines: revegetated:
1,434 = Total acreage revegetated during 5-year period.
770 = Total sediment yield computed using an integrated approach. Using one fifth of the area for each year and assuming that the first year's reclamation will be in effect for four years, the second for three years, etc., the total sediment yield was computed as follows:
2,870 x 0.1 x 2.7 = 770 tons
Where: 2,870 = Acre years revegetated.
0.1 = Estimated sediment yield in acre-feet per square mile.
2.7 = Conversion factor to convert acre-feet per square mile to tons per acre.

3) Underground mines:
200 x 0.8 x 2.7 = 430 tons
Where: 200 = Total acreage disturbed during 5-year period.
0.8 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

4) Power Plants:
1000 x 0.8 x 2.7 = 2,160 tons
Where: 1000 = Total acreage disturbed during 5-year period.
0.8 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

5) Roads, new:
420 x 1.7 x 2.7 = 1,930 tons
Where: 420 = Total acreage disturbed during 5-year period.
1.7 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

6) Roads, revegetated:
250 = Total acreage revegetated during 5-year period.
270 = Total sediment yield computed using an integrated approach as explained for Surface mines, revegetated above.
500 x 0.2 x 2.7 = 270 tons
Where: 500 = Acre years revegetated during 5-year period.
0.2 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

7) Railroads, new (W. R. Grace, Route A including area disturbed by rechannelization of Milk Creek in canyon:)
420 x 3.5 x 2.7 = 4,000 tons
Where: 420 = Total acreage disturbed.
3.5 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

8) Railroads, revegetated:
420 = Total acreage revegetated during period.
1,160 = Total sediment yield computed using an integrated approach as explained for Surface mines, revegetated excepting that the railroad construction was assumed to take two years and revegetation was assumed to have been started in the third year during the 1976-80 period.
252 x 1.7 x 2.7 = 1,160 tons
Where: 252 = Acre years revegetated.
1.7 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

9) Population:
1,070 x 0.8 x 2.7 = 2,310 tons
Where: 1,070 = Total acreage disturbed for housing and associated activities during 5-year period.
0.8 = Estimated sediment yield in ac-ft/sq. mi.
2.7 = Conversion factor.

10) Mine facilities:
400 x 1.7 x 2.7 = 1,840 tons
Where: 400 = Total acreage disturbed for mine maintenance building, etc. during 5-year period.
1.7 = Estimated sediment yield in ac-ft/sq mi.
2.7 = Conversion factor.

TABLE V-2
(Computations for Tables RV-3, RVI-2, RVII-2 Regional Analysis)
1981-85

Estimates and assumptions which were used to compute the total sediment yield follow:

1) Surface mines:
9,470 x 1.7 x 2.7 = 43,500 tons
Explanation same as for Table RV-2.

2) Surface mines, revegetated:
22,235 x 0.1 x 2.7 = 6,000 tons
Explanation same as for Table RV-2.

3) Underground mines:
300 x 0.8 x 2.7 = 650 tons
Explanation same as for Table RV-2.

4) Power plants:
1,000 x 0.8 x 2.7 = 2,160 tons
Explanation same as for Table RV-2.

5) Roads, new:
1,150 x 1.7 x 2.7 = 5,280 tons.
Explanation same as for Table RV-2.

6) Roads, revegetated:
2,950 x 0.2 x 2.7 = 1,590 tons
Explanation same as for Table RV-2.

7) Railroads, new:
60 x 2.0 x 2.7 = 320
Explanation same as for Table RV-2.

8) Railroads, revegetated:
2,260 x 1.7 x 2.7 = 10,400 tons.

9) Population:
No change during 5-year period.

10) Mine facilities:
300 x 1.7 x 2.7 = 1,380 tons
Explanation same as for Table RV-2.

TABLE V-3

(Computations for Tables RV-4, RVI-3, RVII-3 Regional Analysis)
1986-90

All items were computed as for those in Table RV-2. Figures used for items 2), 6) and 8) follow:

2) Surface mines, revegetated:
64,015 x 0.1 x 2.7 = 17,300 tons
Explanation same as for Table RV-2.

6) Roads, revegetated:
7,760 x 0.2 x 2.7 = 4,190 tons
Explanation same as for Table RV-2.

8) Railroads, revegetated:
7,536 x 1.7 x 2.7 = 34,600 tons.
Explanation same as for Table RV-2.

Tables RV-2, RVI-1, and RVII-1 as well as RV-3, RVI-2, and RVII-2, and RV-4, RVI-3, and RVII-3 are identical and are presented in three chapters to indicate total sediment yield, decrease due to mitigation, and residuals.

The figures of total sediment yield are explained above. The other two columns were obtained by applying estimated values for mitigation in percent and computing the decrease in yield and the difference of the total yield and decrease as the residual.

Surface Water Quality

TABLE V-4

Physical Water Quality at Selected Stream Sites in the Analysis Area

		Location		Field Observations			
STATION NAME 1/	DATE	PRINCIPAL MERIDIAN	TOWNSHIP AND RANGE	TEMPERATURE, °C	pH	SPECIFIC CONDUCTANCE MICROMHOS PER CENTIMETER AT 25°C	STREAM CONDITION 2/
MOFFAT COUNTY							
SF White R bl Swede C nr Buford, CO	10-19-71	S	T.1S.,R.91W.	4.0	7.8	300	--
Coal C bl Ninemile Draw nr Meeker, CO	10-19-71	S	T.2N.,R.92W.	7.0	7.8	450	--
Spring C tr nr Maybell, CO	5-18-72	S	T.7N.,R.95W.	--	--	--	NF
Jubb C nr mouth nr Axial, CO	5-17-72	S	T.5N.,R.93W.	--	--	--	NF
Wilson C ab Jubb C nr Axial, CO	5-17-72	S	T.5N.,R.93W.	16.5	8.4	2000	VST
Good Spring C at Axial, CO	5-17-72	S	T.4N.,R.93W.	18.0	8.5	1600	ST
Milk C ab Good Spring C at Axial, CO	5-17-72	S	T.4N.,R.92W.	14.0	8.3	335	SM VT
Deer C nr mouth nr Hamilton, CO	5-18-72	S	T.4N.,R.91W.	13.0	8.3	460	SM T
Morapos C nr Hamilton, CO	5-18-72	S	T.4N.,R.91W.	10.0	8.4	370	SM
Waddle C nr Hamilton, CO	6-6-72	S	T.4N.,R.90W.	15.0	8.0	750	IR OS
SF Williams F ab Pine C nr Pagoda, CO	6-5-72	S	T.3N.,R.90W.	10.0	8.0	150	SM OS
Yampa R tr nr Craig, CO	5-17-72	S	T.6N.,R.91W.	--	--	--	NF
Fortification C ab Ralph White Re, CO	5-18-72	S	T.8N.,R.90W.	11.0	8.1	180	SM VT
L Bear C ab Dry F in Craig, CO	5-17-72	S	T.8N.,R.90W.	12.5	7.9	100	SM T
Elkhead C at mouth of Elkhead, CO	6-6-72	S	T.7N.,R.90W.	19.5	7.6	225	SM T
RIO BLANCO COUNTY							
Stinking Water C at mouth nr Rangely, CO	5-15-72	S	T.1N.,R.102W.	29.0	8.9	8000	YT
Spring C nr Massadona, CO	5-15-72	S	T.2N.,R.101W.	13.5	8.2	8000	SF
L Spring C at mouth nr Massadona, CO	5-16-72	S	T.3N.,R.99W.	11.5	8.7	1880	ST
Strawberry C nr Meeker, CO	5-16-72	S	T.1N.,R.94W.	22.5	8.4	5450	ST
Sulphur C at mouth at Meeker, CO	5-16-72	S	T.1N.,R.94W.	--	--	--	NF
Curtis C at mouth nr Meeker, CO	5-16-72	S	T.1N.,R.94W.	18.0	8.1	7500	VST
EF Williams F ab Poose C nr Pagoda, CO	6-6-72	S	T.3N.,R.88W.	5.5	7.1	130	SM T
Trout C nr Source nr Oak Creek, CO	6-21-72	S	T.2N.,R.87W.	4.0	7.2	100	SM VST

1/, 2/ see page following.

Surface Water Quality

TABLE V-4 (Cont.)

Physical Quality at Selected Sites on Streams in the Analysis Area

		Location		Field Observations			
STATION NAME 1/	DATE	PRINCIPAL MERIDIAN	TOWNSHIP AND RANGE	TEMPERATURE °C	pH	SPECIFIC CONDUCTANCE, MICROMHOS PER CENTIMETER AT 25°C	STREAM CONDITION 2/
ROUTT COUNTY							
Beaver C at mouth nr Pagoda, CO	6-5-72	S	T.4N.,R.89W.	13.5	7.5	185	SM ST
Coal C at mouth nr Pagoda, CO	6-5-72	S	T.3N.,R.89W.	14.5	7.9	1600	SM VST
Elkhead C ab S F nr Elkhead, CO	6-7-72	S	T.9N.,R.87W.	20.0	7.7	120	SM VST
Sage C ab Lower Re nr Mt. Harris, CO	6-7-72	S	T.5N.,R.88W.	16.0	8.6	600	ST
Grassy C nr mouth nr Mt. Harris, CO	6-7-72	S	T.6N.,R.87W.	20.5	7.7	1100	T
Fish C at mouth nr Milner, CO	6-9-72	S	T.5N.,R.86W.	15.5	7.4	560	SM ST
Middle C nr mouth nr Milner, CO	6-9-72	S	T.5N.,R.86W.	15.0	7.2	550	SM T
Deep C bl Smith C nr Deep Creek, CO	6-15-72	S	T.8N.,R.86W.	24.5	8.3	300	--
Oak C bl Haybro, CO	6-9-72	S	T.5N.,R.85W.	15.0	6.7	580	SM T
Oak C bl Oak Creek, CO	6-9-72	S	T.4N.,R.85W.	16.0	8.0	390	SM T
Hunt C at mouth at Phippsburg, CO	6-21-72	S	T.3N.,R.85W.	18.5	8.1	580	SM ST
Yampa R tr nr Elkhead, CO	6-26-72	S	T.6N.,R.89W.	26.0	8.6	3000	YT

Source: U.S. Geological Survey, 1974

1/ Station Name: SF = South Fork, R = River, bl = below, C = Creek, nr = near, CO = Colorado, tr = tributary, ab = above, EF = East Fork, NF = North Fork

2/ Stream Conditions: IR, irrigation return flow suspected; NF, no flow; RO, runoff due to rain; SF, flow primarily from underground spring(s) just upstream; SM, runoff due to snowmelt. BGC, blue-gray coating on rocks; BOC, black-orange coating; GBC, gray-brown coating; OC, orange coating; OTC, orange-tan coating; RC, red coating; ROC, red-orange coating; TC, tan coating. BS, black stain on rocks; GBS, gray-brown stain; OS, orange stain; RS, red stain. BT, water has brown tinge; GT, gray tinge; GBT, gray-brown tinge; OT, orange tinge; WT, white tinge; YT, yellow tinge. VST, water is very slightly turbid; ST, slightly turbid; T, Turbid; VT, very turbid.

TABLE V-5

Existing Reservoirs in Analysis Area and Storage Capacity (Acre-Feet) of Each Reservoir

Name of Reservoir	Source	1973 Nov. 1	1974 May 1	1974 Oct. 31
District No. 43				
Beaver Lake Reservoir	Vaughan Creek	7.45	7.45	7.45
Big Beaver Creek Reservoir	Big Beaver Creek	6,000.	7,657.86	7,657.0
Big Lick Reservoir	Big Beaver Creek	400.	361.16	291.33
Cabin Lake Reservoir	Vaughan Creek	16.00	16.06	16.06
Gregor Reservoir	Vaughan Creek	47.0	47.0	47.0
Keystone Reservoir No. 3	Price Creek	3.5	31.8	11.0
Lady Lake Reservoir	Vaughan Creek	4.41	4.41	4.41
Larson Reservoir	Nineteen Mile Creek	61.9	61.9	61.9
Lunney Reservoir	Ninemile Draw	41.6	82.12	41.12
McHatton Reservoir	Coal Creek	Dry	Dry	Dry
Procter Reservoir	Curtis Creek	6.66	6.66	6.66
Seventh Lake Reservoir	Vaughan Creek	2.12	2.12	2.12
Stump Lake Reservoir	Vaughan Creek	10.23	10.23	10.23
West Miller Reservoir	West Miller Creek	29.8	77.8	48.
West Stewart Reservoir	West Stewart Creek	13.3	13.3	13.3
Wilson Reservoir	East Flag Creek	Dry	Dry	Dry
Black Gulch Reservoir	Black Gulch	Dry	Dry	Dry
District No. 44				
Anderson Reservoir	Cottonwood Creek	10.1	20.1	0
Biskup Reservoir	Biskup Gulch	0	135.8	0
Bunker Lake Reservoir	Bunker Creek	113.0	191.48	100.0
Cove Lake Reservoir	Morapos Creek	46.2	46.2	10.0
Cove Reservoir	Morapos Creek	67.7	67.7	67.7
D.D. & E. Reservoir	Hullett Draw	0	1,408.0	324.0

TABLE V-5 (Cont.)

Existing Reservoirs in Analysis Area and Storage Capacity (Acre-Feet) of Each Reservoir

Name of Reservoir	Source	1973 Nov. 1	1974 May 1	1974 Oct. 31
District No. 44 (Cont.)				
Dresher Reservoir	Lon Gulch	200.0	240.0	100.0
Dunkley Dubeau Reservoir	Willow Creek	112.0	112.9	40.9
Elgin Reservoir	Bell Rock Gulch	0	132.00	0
Elgin Reservoir N. 2	McLernon Draw	0	52.68	0
Freeman Reservoir	Little Cottonwood Creek	137.0	137.0	137.0
Konopil Reservoir	Clear Creek	0	13.3	0
Pitney Reservoir	Corral Gulch	0	11.23	11.23
Poose Creek Reservoir	Poose Creek	227.0	227.0	227.0
Ralph White Reservoir	Fortification Creek	605.0	605.0	605.0
Ruby Reservoir	Morapos Creek	0	26.0	0
Sellers Crowell Reservoir	Willow Creek	22.	106.	33.
Shafer Reservoir	Willow Creek	81.	81.	81.
Waddle Creek Reservoir	Waddle Creek	39.0	39.0	39.0
Wilson Reservoir	Good Springs Creek	68.0	68.0	68.0
Wyman Reservoir	Beaver Creek	95.7	95.7	95.7
District No. 54				
Cull Reservoir	Trib. Four Mile Creek	0	250.0	250.0
Elk Lake Reservoir	Willow Creek	0	199.2	398.4
Cold Blossom Reservoir	Gold Blossom Creek	0	0	0
Lake Fork Reservoir	Lake Fork Creek	44.3	44.3	44.3
Lower Cogdill Reservoir	Government Corral Creek	173.44	173.44	173.44
Perkins Fox Reservoir	Trib. West Willow Creek			
Skunk Creek Reservoir	Skunk Creek	15.32	15.32	15.32
Upper Cogdill Reservoir	Government Corral Creek	45.4	45.4	45.4

TABLE V-5 (Cont.)

Existing Reservoirs in Analysis Area and Storage Capacity (Acre-Feet) of Each Reservoir

Name of Reservoir	Source	1973 Nov. 1	1974 May 1	1974 Oct. 31
District No. 56				
Ainge Reservoir	Flynn Spring	.5	4.46	.5
Bassett Reservoir No. 1	Bull Canyon Gulch	0	0	0
Bassett Reservoir No. 2	Bull Canyon Gulch	40.0	54.0	40.0
Dry Lake Reservoir	Pot Creek	7.0	6.0	0
Haunted Spring Reservoir	Haunted Spring Gulch	.5	8.0	0
Massey Reservoir	Flynn Spring	5.0	7.0	0
Offield Reservoir	Pot Creek	64.0	50.0	5.0
T. W. Blevins Reservoir	Spring T. Vermillion Creek	3.0	4.0	6.0
District No. 57				
Greasewood Flats Reservoir	Dill Gulch	Dry	24.80	Dry
Apple Reservoir	Dry Creek	Dry	10.72	1.0
Ponds to Hayden Station	Yampa River	1,013.3	1,013.3	1,013.3
Brock Reservoir	Trib. To Yampa River	6.84	6.84	6.84
J.C. Temple Reservoir No. 1	Temple Gulch	87.0	553.0	70.0
J.M. Yoast Reservoir	Yoast Creek	Dry	147.0	Dry
Morgan Creek Reservoir No. 1	Morgan Creeek	51.6	320.0	12.3
Sage Creek Reservoir	Sage Creek	210.0	379.0	141.0
Seaton Reservoir	Middle Fish Creek	Dry	20.8	Dry
Sheriff Reservoir	Trout Creek	986.5	986.5	986.5
Yoast Reservoir No. 1, No. 2	Yoast Creek	Dry	6.83	Dry
District No. 58				
Allen Basin Reservoir	Middle Hunt Creek	1,023.	1,758.	790.
Alma Baer Reservoir	Fish Creek	0	0	0
Bear Lake Reservoir	Deadmans Creek	0	0	2.6

TABLE V-5 (Cont.)

Existing Reservoirs in Analysis Area and Storage Capacity (Acre-Feet) of Each Reservoir

Name of Reservoir	Source	1973 Nov. 1	1974 May 1	1974 Oct. 31
District No. 58 (Cont'd)				
Bison Park Reservoir	Lawson Creek	0	30.0	0
Bull Park No. 2 Reservoir	West Branch Watson Creek	0		
Burnt Mesa Reservoir	South Hunt Creek	0	40.0	30.0
Chapman Reservoir	Little Oak Creek	100.	246.	50.
Crowner Reservoir	Beaver Creek	0	58.	0
Fish Creek Reservoir	Fish Creek	1,175.	1,842.	1,426.
Fish Lake Reservoir No. 2	Wheeler Creek	35.0	35.0	35.
Franch Reservoir	Jack Creek	Empty	7.	3.
Gardner Reservoir	Gardner Creek	1,051.	1,155.	1,077.
Hahns Peak Reservoir	Willow Creek	600.5	600.5	600.5
Heart Lake Reservoir	Watson Creek	77.	283.	0
LaForce Reservoir No. 1	Jack Creek	-	2.	2.
LaForce Reservoir No. 2	Jack Creek	-	6.	4.
LaForce Reservoir No. 3	Jack Creek	-	6.	4.
Lake Creek Reservoir	Wheeler Creek	292.	292.	292.
Lake Windemere	Farnsworth Creek	137.4	137.4	137.4
Lee Reservoir	Chimney Creek	0	0	0
Lester Creek Reservoir	Lester Creek	5,657.	5,657.	5,657.
Long Lake Reservoir	Fish Creek	112.	395.65	62.
Lowry Reservoir	Pinnacle Creek	0	0	0
Martin Reservoir	Yellow Jacket Creek	20.0	80.0	10.
May Reservoir	Salt Creek	6.	6.	6.
McChivvis Reservoir	Watson Creek	0	191.	50.
Milk Creek Reservoir	Milk Creek	0	0	0
Moore Park Reservoir	Elgin Creek	0	20.	10.

TABLE V-5 (Cont.)

Existing Reservoirs in Analysis Area and Storage Capacity (Acre-Feet) of Each Reservoir

Name of Reservoir	Source	1973 Nov. 1	1974 May 1	1974 Oct. 31
District No. 58 (Cont'd)				
Oak Creek Reservoir	Oak Creek	3.	3.	3.
Osborn Reservoir	Raspberry Creek	0	0	0
Rams Horn Reservoir	Dome Creek	122.		
Reynolds Reservoir	Bruch Creek	0	0	0
Roland Reid Reservoir No. 1	Ft. Willy Gulch	45.	45.	45.
Sandelin Reservoir No. 1	Big Creek	2.5	2.5	2.5
Sandelin Reservoir No. 2	Big Creek	7.0	7.0	7.0
Sandelin Reservoir No. 3	Big Creek	6.8	6.8	6.8
Simon Reservoir	Middle Hunt Creek	455.	707.	440.
Stillwater Reservoir No. 1	Yampa River	3,711.	3,711.	3,070.
Stillwater Reservoir No. 3	Yampa River	620.	620.	620.
Stukey Distribution Reservoir	Spring Creek	4.6	4.6	4.6
Summer Reservoir	Young Creek	0	.20	.07
Tillquist Lake Reservoir	Morrison Creek	2.	5.	5.
Trull Creek Reservoir	Trull Creek	0	149.	0
Upper Willow Creek Reservoir	Willow Creek	23,604.	23,604.	23,604.
Wheeler Reservoir	Wheeler Creek	37.0	37.0	37.0
Willy Reservoir	Cow Creek	2.61	2.61	
Whitney Nelson Reservoir	Whipple Creek	200.	432.	300.
Younger Reservoir	Morrison Creek	Full	Full	Full

SOURCE: Colorado Division of Water Resources, 1974.

Water Resources

Water Quality

TABLE V-6

Evaluation of Discharges From Sewage Treatment Plants in the Analysis Area

Treatment Plant and Date	Dissolved Oxygen mg/1	Turbidity jtu	Solids Settleable mg/1	Solids Suspended mg/1	BOD5 mg/1	Fecal Coliform per 100 ml	Type of Sample
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Health Dept. Standards	2.0	30	0.5	30	30	5,000	3-hour
Morrison Creek							
5-24-73	9.0	NA	0.1	31	NA	22	Grab
Timbers							
9-25-73	11.9	34	0.1	115	31	24,000	Grab
Oak Creek							
1-6-72	NA	NA	0.1	44	24	22,000	3-hour
4-6-72	NA	NA	0.6	40	17	NA	4-hour
7-26-72	NA	NA	0.0	5	16	2,000	6-hour
5-24-73	8.5	NA	0.1	28	28	22,000	6-hour
Mt. Werner							
1-5-72	NA	NA	0.1	33	48	2,400,000	6-hour
7-18-72	NA	NA	25.0	NA	67	NA	6-hour
1-10-73	4.6	102	0.1	41	63	480,000	6-hour
Fish Creek Park							
7-18-72	NA	NA	67.0	118	80	NA	6-hour
1-10-73	3.2	285	0.1	186	139	55,000	6-hour
5-24-73	3.9	12	0.1	50	23	2,200,000	6-hour

Abbreviations used: NA, not available; mg/1, milligrams per liter; jtu, Jackson Turbidity Units; BOD5, Biological Oxygen Demand 5-day

TABLE V-6 (Cont.)

Treatment Plant and Date	Dissolved Oxygen mg/1	Turbidity jtu	Solids Settleable mg/1	Solids Suspended mg/1	BOD5 mg/1	Fecal Coliform per 100 ml	Type of Sample
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bear Pole Ranch							
9-25-73	15.0	56	0.1	176	63	2	6-hour
Whiteman School							
9-25-73	10.4	29	0.2	202	117	22,000	6-hour
Steamboat Springs							
6-7-72	NA	NA	0.1	46	26	3,800	6-hour
7-19-72	NA	NA	7.0	17	35	NA	6-hour
1-9-73	5.4	33	0.0	27	26	45,000	6-hour
5-22-73	7.9	6	0.1	33	22	2,400	24-hour
9-25-73	3.3	9	0.1	23	13	2,200	22-hour
KOA Campground							
9-6-72	NA	NA	97.0	130	220	NA	Grab
1-11-73	NA	140	0.1	105	134	57,000	Grab
10-16-73	8.2	26	0.7	120	36	2,400	6-hour
Sleepy Bear Park							
1-5-72	NA	NA	0.1	45	48	2,400,000	6-hour
1-11-73	5.4	276	0.0	93	46	100	6-hour
5-22-73	0.7	NA	0.1	25	33	2,200	24-hour
Steamboat II							
6-7-72	NA	NA	0.1	25	11	15	Grab
9-6-72	NA	NA	18.0	32	13	NA	6-hour
1-9-73	5.2	57	0.7	80	48	127,000	6-hour
5-23-73	9.1	NA	0.2	31	16	2,200	6-hour
10-16-73	5.2	13	0.1	32	39	380	6-hour

Abbreviations used: NA, not available; mg/1, milligrams per liter; jtu, Jackson Turbidity Units; BOD5, Biological Oxygen Demand 5-day

Water Quality

TABLE V-6 (Cont.)

Treatment Plant and Date	Dissolved Oxygen mg/l	Turbidity jtu	Solids		BOD5 mg/l	Fecal Coliform per 100 ml	Type of Sample
			Settleable mg/l	Suspended mg/l			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hayden							
4-6-72	NA	NA	0.6	40	17	NA	4-hour
5-21-72	NA	NA	5.0	9	21	5,400	6-hour
7-26-72	NA	NA	0.0	5	16	2,000	6-hour
5-8-73	4.2	NA	0.1	31	NA	22	Grab
Big Country Meats							
5-8-73	5.2	NA	0.3	166	NA	22	6-hour
Craig STP							
8-30-72	NA	52	28.0	42	20	2,000	Grab
5-8-73	15.0	NA	0.1	78	37	38,000	6-hour
10-17-73	8.8	14	0.1	24	12.5	2,200	8-hour
Meeker							
6-23-71	NA	NA	0.4	45	13	22,000	4-hour
8-15-72	NA	NA	80.0	451	243	22,000	Grab
9-12-72	NA	NA	50.0	295	91	22,000	6-hour
10-17-73	1.8	88	2.0	245	83	240	5-hour
Rangely							
9-10-70	NA	NA	0.1	74	16	30,000	Grab
12-2-70	NA	NA	0.1	43	29	30,000	Grab
8-15-72	NA	NA	0.1	25	15	2,200	Grab
5-10-73	14.2	NA	0.1	23	13.5	2,400	16-hour

SOURCE: Colorado State Health Department, 1974

Abbreviations used: NA, not available; mg/l, milligrams per liter; jtu, Jackson Turbidity Units; BOD5, Biological Oxygen Demand 5-day

TABLE V-7

Leading and Estimated Infiltration of Sewage Treatment Plants in the Analysis Area

Treatment Plant	Reported Design Capacity gpd	Reported Avg. Flow at Treatment Plant gpd	Estimated Population	Flow at 100 gpcd	Estimated Infiltration gpd	Index of Infiltration Col. (3) : Col. (5)	Estimated Economic Infiltration Reduction %	Estimated Economic Infiltration Reduction gpd	Estimated Infiltration After Correction gpd
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Oak Creek	250,000	250,000	700	70,000	180,000	3.57	60	108,000	72,000
Mt. Werner	65,000	250,000	700	70,000	180,000	3.57	60	108,000	72,000
Steamboat Springs	650,000	1,900,000	2,700	270,000	1,630,000	7.04	55	902,000	728,000
Hayden	250,000	600,000	1,300	130,000	470,000	4.62	65	305,000	165,000
Craig	600,000	660,000	4,600	460,000	200,000	1.44	NA	NA	200,000
Meeker	250,000	270,000	1,650	165,000	105,000	1.64	NA	NA	105,000
Rangely	300,000	200,000	1,600	160,000	40,000	1.25	NA	NA	40,000

SOURCE: Colorado State Health Department, 1974

Abbreviations used: NA, Not available
Col., Column
gpd, gallons per day
gpcd, gallons per capita per day

TABLE V-8

Dissolved Solids in Selected Wells, Streams and Mine Pits

	Consolidation Fuels Test Holes 1	2	Energy 1 Pit 3	Foidel Creek Near Tipple 4	Foidel Creek Near Foidel School 5	Energy 2 Pit 6	Monitor Well P-2 7	Seneca 2 Pit 8	Seneca 2 Shop Well 9
Calcium mg/1	37	34	410	71	140	75	64	250	200
Magnesium mg/1	21	21	180	35	71	29	77	170	77
Potassium mg/1	13	3	6	3	3	3	4	10	4
Sodium mg/1	200	190	64	19	36	44	76	160	31
Bicarbonate mg/1	710	583	217	313	305	314	518	416	557
Chloride mg/1	4	3	7	4	6	7	4	18	21
Fluoride mg/1	0.8	1.3	0.3	0.3	0.3	0.3	0.1	0.4	0.3
Sulfate mg/1	39	120	1,500	84	430	80	220	1,300	420
$NO_2 + NO_3$ as ND mg/1	0.01	0.02	18	0.00	1.4	13	0.00	5.0	0.07
Silica mg/1	9.6	16	54	8.8	5.3	11	14	5.8	14
TDS mg/1	677	676	2,360	380	848	462	720	2,140	1,050
Arsenic µg/1	0	0	0	2	1	0	0	0	0
Cadmium µg/1	0	0	1	0	0	1	0	1	4
Cobalt µg/1	0	0	0	0	0	1	0	0	0
Copper µg/1	0	0	3	3	4	5	0	0	250*
Iron µg/1	2,200	390	40	110	90	60	2,000	30	90
Lead µg/1	0	1	0	0	0	0	0	1	0
Manganese µg/1	80	0	20	70	110	80	50	70	17
Mercury µg/1	0.0	0.0	0.0	0.0	10.2	0.0	0.1	0.0	0.0
Molybdenum µg/1	0	0	1	0	0	3	0	1	0
Nickel µg/1	2	0	9	4	2	3	1	14	0
Selenium µg/1	0	0	47*	0	3	0	0	5	4
Vanadium µg/1	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Zinc µg/1	8	10	20	10	8	4	2,200 [1/]	30	20
Conductivity	1,090	1,080	2,850	600	1,200	740	1,500	2,420	1,450
pH	7.7	7.6	7.6	7.8	8.1	7.8	6.9	7.5	7.5
SAR	6.5	6.3	0.7	0.5	0.6	1.1	1.5	1.9	0.5
Water Temperature	14.5	18.0	18.5	23.8	22.0	25.0	10.0	16.0	20.5

[1/] Excessive value (probably due to contamination of sample).

TABLE V-9

Chemical Water Quality at Selected Stream Sites in the Analysis Area

STATION NAME 2/	DATE	Location 1/		Trace Elements, Micrograms per Liter															
		PRINCIPAL MERIDIAN	TOWNSHIP AND RANGE	ARSENIC (As)	CADMIUM (Cd)	CHROMIUM (Cr)	COBALT (Co)	COPPER (Cu)	IRON (Fe)	LEAD (Pb)	MAGANESE (Mn)	MERCURY (Hg)	MOLYBDENUM (Mo)	NICKEL (Ni)	SELENIUM (Se)	SILVER (Ag)	VANADIUM (V)	ZINC (Zn)	SULFATE (SO_4), MILLIGRAMS PER LITER
MOFFAT COUNTY																			
Stinking Gulch at Iles Grove, CO	5-18-72	S	T.5N.,R.92W.	1	0	-	0	1	20	0	13	0.0	-	1	-	0	-	10	590
Good Spring C at Axial, CO	5-17-72	S	T.4N.,R.93W.	0	0	-	0	1	20	3	80	0.0	-	4	-	0	-	10	540
Coal Gulch nr Craig, CO	5-18-72	S	T.8N.,R.90W.	5	0	-	0	3	20	1	25	0.2	-	8	-	0	-	30	1200
Deacon Gulch nr Craig, CO	6-6-72	S	T.6N.,R.90W.	3	0	-	0	0	10	1	490	0.0	-	5	-	0	-	20	2000
RIO BLANCO COUNTY																			
Spring C nr Massadona, CO	5-15-72	S	T.2N.,R.101W.	1	0	-	3	1	130	3	1200	0.0	-	12	-	0	-	20	4700
Yellow C nr White River, CO	5-16-72	S	T.2N.,R.98W.	4	0	-	0	2	10	2	0	0.0	-	2	-	0	-	10	660
Crooked Wash at mouth nr Massadona, CO	5-16-72	S	T.3N.,R.98W.	3	0	-	0	5	20	1	25	0.0	-	6	-	0	-	20	1300

1/, 2/ see page following

TABLE V-9 (Cont.)

Chemical Quality at Selected Stream Sites in the Analysis area

STATION NAME 2/	DATE	Location 1/		Trace Elements, Micrograms per Liter															
		PRINCIPAL MERIDIAN	TOWNSHIP AND RANGE	ARSENIC (As)	CADMIUM (Cd)	CHROMIUM (Cr)	COBALT (Co)	COPPER (Cu)	IRON (Fe)	LEAD (Pb)	MAGANESE (Mn)	MERCURY (Hg)	MOLYBDENUM (Mo)	NICKEL (Ni)	SELENIUM (Se)	SILVER (Ag)	VANADIUM (V)	ZINC (Zn)	SULFATE (SO_4), MILLIGRAMS PER LITER
ROUTT COUNTY																			
Cedar C at mouth nr Pagoda, CO	6-5-72	S	T.3N.,R.89W.	2	0	-	0	1	20	3	0	0.0	-	3	-	0	-	0	130
Coal C at mouth nr Pagoda, CO	6-5-72	S	T.3N.,R.89W.	0	0	-	0	1	30	1	38	0.0	-	4	-	0	-	20	690
Grassy C nr mouth nr Mt. Harris, CO	6-7-72	S	T.6N.,R.87W.	0	0	-	0	0	20	1	810	0.0	-	6	-	0	-	10	300
Trout C ab Middle C nr Milner, CO	6-9-72	S	T.5N.,R.85W.	1	0	-	0	1	130	2	0	0.0	-	3	-	0	-	30	15
Oak C Drain nr Oak Creek, CO	6-9-72	S	T.4N.,R.85W.	1	0	-	1	0	7000	3	180	0.0	-	12	-	0	-	40	1600

SOURCE: U.S. Geological Survey, 1974

1/ PRINCIPAL MERIDIAN: NM, New Mexico; S, Sixth; U, Ute.

2/ STATION NAME: ab, above; bl, below; Bk, Brook; Cn, Canyon; CO, Colorado; Co., County; C, Creek; di, distributary; D, Ditch; E, East: F, Fork; Ft., Fort; Gdn, Golden; Gl, Gulch; Hwy, Highway; Lk, Lake; L, Little; M, Middle; mo, mouth; Mtn, Mountain; nr, near; No., Number; Re, Reservoir; R, River; St., Saint; stp, sewage treatment plant; S, South; Spgs, Springs; tr, tributary; U.S., United States; W, West.

TABLE V-10

Trace Element Analyses for Several Stream Sampling Sites in April and May 1974

Parameters	Upper Dry Creek	Northern Tributary To Dry Creek	Lower Dry Creek	Upper Sage Creek	Below Sage Creek Reservoir	Lower Sage Creek	Grassy Creek
Date of collection	4-30-74	5-29-74	4-30-74	4-30-74	4-30-74	4-30-74	4-30-74
Fluoride (mg/l)	.18	.21	.30	.11	.13	5.22	.13
Aluminum (μg/l)	100	900	9,800	<100	<100	2,400	4,200
Copper (μg/l)	<10	10	20	<10	<10	<10	<10
Nickel (μg/l)	37	<33	74	<37	<37	74	<37
Manganese (μg/l)	0	90	610	0	330	320	180
Iron (μg/l)	120	970	17,600	40	380	4,300	6,400
Zinc (μg/l)	100	8	185	105	90	135	160
Cadmium (μg/l)	<9	<9	<9	<9	<9	<9	<9
Chromium, Total (μg/l)	15	<13	30	15	20	10	10
Lead (μg/l)	16	54	58	8	24	41	33
Mercury (μg/l)	0	-	.06	.01	.01	.04	.06
Arsenic (μg/l)	<1	2.7	11	<1	<1	3	3
Selenium (μg/l)	<1	<3	<1	<1	<1	<1	<1
Calcium (mg/l)	55	160	80	30	90	50	30
Magnesium (mg/l)	34	180	52	16	47	30	22
Sodium (mg/l)	24	140	20	7	18	18	26
Antimony (μg/l)	<0.8	<3	<0.8	<0.8	<0.8	<0.8	<0.8
Potassium (mg/l)	6	25	7	3	4	6	8
Silver (μg/l)	<5	-	12	<5	<5	<5	<5
Boron (μg/l) 1/	-	-	-	-	-	-	-
Vanadium (μg/l)	<100	<100	<100	<100	<100	<100	<100
Lithium (μg/l)	<25	70	25	<25	<25	<25	<25
Beryllium (μg/l)	<10	<10	<10	<10	<10	<10	<10
Molybdenum (μg/l)	24	<32	<24	<24	<24	<24	<24
Cobalt (μg/l)	<29	<34	59	29	<29	<29	<29

1/ Values obtained for this parameter appeared to be in error and will be compared with later analyses before being reported.

TABLE V-11

Concentration and discharge of dissolved solids and suspended sediment for streams in the Yampa River Basin. (Data represent annual average for the water years 1914 - 57 adjusted to 1957 conditions.)

Stream	Water discharge (thousands of acre-feet per year	Dissolved solids			Suspended sediment		
		Weighted-average concentration (ppm)	Discharge		Weighted-average concentration (ppm)	Discharge	
			Thousands of tons per year	Tons per square mile per year		Thousands of tons per year	Tons per square mile per year
Yampa River near Oak Creek	63.	221	19.	84	--	--	--
Yampa River at Steamboat Springs	342.	74	34.	57	--	--	--
Elk River at Clark	258.	40	14.	67	--	--	--
Elk River near Trull	394.	47	25.	61	--	--	--
Fortification Creek near Craig	9.7	774	10.	298	--	--	--
Williams Fork at Hamilton 1/	158.	234	50.	148	--	--	--
Yampa River near Maybell	1,152.	140	219.	61	196	308	90
Little Snake River near Slater	188.	78	20.	70	--	--	--
Slater Fork near Slater	61.	101	8.4	52	212	18	109
Little Snake River near Lily	451.	196	120.	36	1,790	1,099	295

1/ For 1905 - 06, 1910 - 27 water years
SOURCE: U.S. Geological Survey, 1974
Abbreviations used: ppm, parts per million

TABLE V-12

Biological Quality of Surface Water at Sites Sampled in the Study Region

See bottom of last page of table for legend.

Location 2/				Aquatic Organisms 3/											
				Flora				Fauna							
Station Name 1/	Date	Principal Meridian	Township and Range	Rooted Aquatics	Diatoms	Green Algae	Blue-green Algae	Mayflies	Stoneflies	Caddisflies	Beetle Larvae	Midges	Black Flies	Snails	Leeches
Moffat County															
Spring C ab unnamed tr nr Maybell, CO	5-18-72	S	T7NR95W	A	P-C	P	A	A	A	P	A	P	P	A	A
Wilson C ab Jubb C nr Axial, CO	5-17-72	S	T4NR93W	A	C	P	A	C	P-C	C	A	A	A	P	A
Milk C ab Good Spring C nr Axial, CO	5-17-72	S	T4NR92W	A	C	A	A	P-C	P	A	A	A	A	A	A
Deer C nr mouth at Hamilton, CO	5-18-72	S	T4NR91W	A	P-C	P	A	C	P	P	A	A	A	A	A
Morapos C nr Hamilton, CO	5-18-72	S	T4NR91W	A	C	A	A	P-C	A	P	A	P	P-C	P	A
Pine C at mouth nr Pagoda, CO	6-5-72	S	T4NR91W	A	P	P	A	P	P-C	P	A	P	C+	A	A
Fortification C ab Ralph White Re, CO	5-18-72	S	T8NR90W	-	-	-	-	P	A	A	A	A	A	A	A
L Bear C ab Dry F nr Craig, CO	5-17-72	S	T8NR90W	A	P-C	A	A	A	A	A	A	A	P	A	A
Dry F L Bear C at mouth nr Craig, CO	5-17-72	S	T8NR90W	A	C	A	A	A	P	P	A	P-C	A	A	A
Elkhead C at mouth at Elkhead, CO	6-6-72	S	T7NR90W	A	C	P	A	P	P	P	A	P	C	A	A

TABLE V-12 (Cont.)

Biological Quality of Surface Water at Sites Sampled in the Study Region

See bottom of last page of table for legend.

Location 2/				Aquatic Organisms 3/											
				Flora				Fauna							
Station Name 1/	Date	Principal Meridian	Township and Range	Rooted Aquatics	Diatoms	Green Algae	Blue-green Algae	Mayflies	Stoneflies	Caddisflies	Beetle Larvae	Midges	Black Flies	Snails	Leeches
Rio Blanco County															
SF White R bl Swede C nr Buford, CO	10-19-71	S	T15R91W	A	P-C	P	A	C	C	C	A	A	A	A	A
Coal C bl Ninemile Draw nr Meeker, CO	10-19-71	S	T2NR92W	A	P-C	P-C	A	C	C	C	A	A	A	C	A
Trull C at mouth nr Milner, CO	10-15-71	S	T7NR85W	P	A	C	A	P	P	A	A	A	A	C	A
Willow C at mouth nr Clark, CO	10-14-71	S	T9NR85W	A	P(?)	P	A	C	C	C	A	A	A	A	A
Beaver C at mouth nr Hahns Peak, CO	10-14-71	S	T9NR85W	P-C	A	P-C	A	C	C	C	A	A	A	A	A
Stinking Water C at mouth nr Rangely, CO	5-15-72	S	T1NR102W	A	P-C	A	A								
Douglas C nr mouth nr Rangely, CO	5-15-72	S	T1NR101W	A	P	P-C	A	C	A	A	A	P	A	A	A
E Douglas C at mouth nr Rangely, CO	5-15-72	S	T25R101W	-	-	-	-	A	A	P	A	P	A	A	A
Spring C nr Massadona, CO	5-15-72	S	T2NR101W	A	P-C	P-C	A	A	A	A	A	P-C	A	A	A
L Spring C at mouth nr Massadona, CO	5-16-72	S	T3NR99W	P	P-C	P-C	A	A	A	P	A	P	P	A	A

TABLE V-12 (Cont.)

Biological Quality of Surface Water at Sites Sampled in the Study Region

See bottom of last page of table for legend.

Location 2/				Aquatic Organisms 3/											
				Flora				Fauna							
Station Name 1/	Date	Principal Meridian	Township and Range	Rooted Aquatics	Diatoms	Green Algae	Blue-green Algae	Mayflies	Stoneflies	Caddisflies	Beetle Larvae	Midges	Black Flies	Snails	Leeches
Rio Blanco County (Contd)															
Strawberry C nr Meeker, CO	5-16-72	S	T1NR94W	A	P(?)	A	A	A	P	A	A	A	A	A	A
Flag C ab Meeker, CO	5-16-72	S	T1SR94W	A	C	A	A	-	-	-	-	-	-	-	-
Curtis C at mouth nr Meeker, CO	5-16-72	S	T1NR94W	A	C	P	A	A	A	P	A	A	A	P	A
L Beaver C at mouth nr Meeker, CO	5-16-72	S	T1NR93W	-	-	-	-	A	A	A	A	P-C	A	P	A
EF Williams F ab Poose C nr Pagoda, CO	6-6-72	S	T3NR88W	-	-	-	-	P-C	P	A	A	A	C	A	A
Trout C nr source nr Oak Creek, CO	6-21-72	S	T2NR87W	A	C	A	A	P-C	P	P	A	A	P	A	A
Routt County															
Beaver C at mouth nr Pagoda, CO	6-5-72	S	T4NR89W	A	P	A	A	P	C	C	A	P	C	A	A
Coal C at mouth nr Pagoda, CO	6-5-72	S	T3NR89W	A	A	P-C	A	A	A	P-C	A	A	A	A	A
Dry F Elkhead C at mouth nr Elkhead, CO	6-6-72	S	T8NR88W	P	C	P	A	A	P	P-C	A	P-C	C	A	A

TABLE V-12 (Cont.)

Biological Quality of Surface Water at Sites Sampled in the Study Region

See bottom of last page of table for legend.

Location 2/				Aquatic Organisms 3/											
				Flora				Fauna							
Station Name 1/	Date	Principal Meridian	Township and Range	Rooted Aquatics	Diatoms	Green Algae	Blue-green Algae	Mayflies	Stoneflies	Caddisflies	Beetle Larvae	Midges	Black Flies	Snails	Leeches
Routt County (Contd)															
NF Elkhead C at mouth nr Elkhead, CO	6-6-72	S	T8NR88W	A	C	P	A	P	P	P	A	P-C	C	A	A
SF Elkhead C nr mouth nr Elkhead, CO	6-7-72	S	T9NR87W	A	C	P	A	P	P	P-C	A	P	P	A	A
Dry Creek nr Hayden, CO	6-7-72	S	T5NR88W	-	-	-	-	P-C	A	P	P	A	P-C	A	A
Sage Cab Lower Re nr Mt. Harris, CO	6-7-72	S	T5NR88W	A	C	A	A	P	P	C	A	P	A	A	A
Grassy C nr mouth nr Mt. Harris, CO	6-7-72	S	T6NR87W	A	P(?)	A	A	A	A	P-C	A	P	A	A	A
Fish C at mouth nr Milner, CO	6-9-72	S	T5NR86W	A	C	P	A	P-C	A	P	A	P	P	A	A
Middle C nr mouth nr Milner, CO	6-9-72	S	T5NR86W	P	C	P	A	P	A	P	A	P-C	A	A	A
Trout C ab Middle C nr Milner, CO	6-9-72	S	T5NR85W	A	C	P	A	P	P	P	A	P	P	A	A
Oak C bl Haybro, CO	6-9-72	S	T5NR85W	P	C	A	A	P	A	C	A	P	A	P	A

TABLE V-12 (Cont.)

Biological Quality of Surface Water at Sites Sampled in the Study Region

Location 2/				Aquatic Organisms 3/											
				Flora				Fauna							
Station Name 1/	Date	Principal Meridian	Township and Range	Rooted Aquatics	Diatoms	Green Algae	Blue-green Algae	Mayflies	Stoneflies	Caddisflies	Beetle Larvae	Midges	Black Flies	Snails	Leeches
Routt County (Contd)															
SF L Snake R at mouth nr Columbine, CO	6-8-72	S	T12NR86W	A	C	P	A	P	P	C	P(?)	P	P	P	A
Slater F ab S F nr Slater, CO	6-8-72	S	T10NR88W	A	C	P	A	A	P	P-C	A	P	P-C	A	A

SOURCE: D.A. Wentz, 1974

1/ STATION NAME: ab, above; bl, below; bk, Brook; Cn, Canyon; CO, Colorado; Co., County; C, Creek; di, distributary; D, Ditch; E, East; F, Fork; Ft., Fort; Gdn, Golden; Gl, Gulch; Hwy, Highway; Lk, Lake; L, Little; M, Middle; mo, mouth; Mtn, Mountain; nr, near; N, North; No., Number; Re, Reservoir; R, River; St., Saint; stp, sewage treatment plant; S, South; Spgs, Springs; tr, tributary; U.S., United States; W, West.

2/ PRINCIPAL MERIDIAN: NM, New Mexico; S, Sixth; U, Ute.

3/ AQUATIC ORGANISMS ("10-rock" riffle sample unless otherwise specified under Miscellaneous): A, absent; 1, one organism observed; P, present; P-C, present to common; C, common; C+, abundant; (?), classification questionable; *, no suitable riffle for sampling rocks.

TABLE V-13

Streamflow Characteristics at Gaging Stations in Study Region

Station number	Station name	Drainage Area (sq mi)	Records Used (years)	Annual Mean Discharge (cfs)		Range of Annual Minimum Daily Discharge (cfs)	Peak Flows								Factors Affecting Natural Flow
							Average recurrence interval (years)					Maximum observed			
				Average	Range		2	5	10	25	50	Date	Discharge	Unit Discharge (cfs/sq mi)	
09236000	Yampa River near Toponas, Colo.	23	1952-65, 1966-73	40.3	31.2-55.7	1.6-15	190	257	305	369	420	July 2, 1957	436	18.9	Flow regulated by Stillwater and Yampa Reservoirs (combined capacity, 6,820 acre-feet)
09237500	Yampa River near Oak Creek, Colo.	227	1939-44, 1956-72	86.1	48.6-160	8.9-40	460	748	976	1,310	--	Apr. 16, 1962	1,400	6.17	Diversions for irrigation of about 12,000 acres above station. Two diversions for irrigation to Egeria Creek in Colorado River basin. Storage in Stillwater and Yampa Reservoirs (total capacity, 6,820 acre-ft).
09237800	Service Creek near Oak Creek, Colo.	38.2	1965-73	45.2	26.7-60.4	2.0-3.0	--	--	--	--	--	May 21, 1970	765	20.0	
09238000	Oak Creek near Oak Creek, Colo.	14	1952-57	8.38	5.14-15.3	1.4-2.4	59	104	—	--	—	May 9, 1957	140	10.0	Diversions for irrigation of about 1,000 acres above station. One diversion imports water from Trout Creek to Oak Creek above station.
09238500	Walton Creek near Steamboat Springs, Colo.	42.4	1920-22, 1965-73	87.4	52.0-143	4.5-9.7	1,260	1,780	2,170	--	--	June 15,1921	2,800 1/	66.0	Diversions above station by Highline Canal from Beaver and Storm King Creeks for irrigation below station.
09239400	Spring Creek near Steamboat Springs, Colo.	6.96	1965-72	9.42	5.76-12.1-	0.08-0.55	93	119	--	--	--	June 5, 1968	138	19.8	Diversions 1.3 miles above station by Steamboat Garden ditch for irrigation in Soda Creek drainage.
09239500	Yampa River at Steamboat Springs, Colo.	604	1904-6 1909-73	467	175-740	4-98	3,680	4,610	5,130	5,690	6,060	June 14, 1921	6,820	11.3	See remarks for stations 09237500 and 09238000. Diversions for irrigation of about 19,700 acres above station.
09240000	Soda Creek at Steamboat Springs, Colo.	47	1910-11, 1912 19	47.8	27.8-72.4	0--	--	--	--	--	--	June 12, 1918	694 1/	14.8	Diversions for irrigation of about 8,000 acres above station.
09240500	Elk River at Hinman Park, Colo.	61	1911-18	199	142-272	---	1,460	1,860	--	--	--	June 12, 1918	2,040	33.4	
09241000	Elk River at Clark, Colo.	206	1910-22, 1930-73	337	179-557	22-54	2,630	3,250	3,610	4,020	4,310	June 6, 9, 1912	4,470 1/	21.7	Diversions above station for irrigation of about 120 acres above and about 460 acres below station.
09242500	Elk River near Trull Colo.	415	1904-6, 1909-27	594	422-886	---	4,140	4,810	5,200	--	--	June 15, 1921	5,530	13.3	Diversions above station for irrigation of about 6,500 acres above and about 1,000 acres below station.
09243000	Trout Creek near Phippsburg, Colo.	16	1953-58	27.4	18.6-39.7	---	278	431	—	--	--	June 30, 1957	565	35.3	Regulation since April 1955 by sheriff. Reservoir (capacity about 900 acre-ft) 1 mile above station. Rich Ditch diverts water above station from Trout Creek basin to Oak Creek basin.
09244100	Fish Creek near Milner, Colo.	34.5	1955-73	12.7	5.62-20.5	0.4-2.2	--	--	--	--	--	May 18, 1970	342	9.91	Diversions above station for irrigation.
09244300	Grassy Creek near Mount	25.8	1958-66	1.44	0.20-	0-0	--	--	--	--	--	Apr. 20, 1965	247	9.57	

TABLE V-13 (Cont.)

Streamflow Characteristics at Gaging Stations in Study Region

Station number	Station name	Drainage Area (sq mi)	Records Used (years)	Annual Mean Discharge (cfs)		Range of Annual Minimum Daily Discharge (cfs)	Peak Flows								Factors Affecting Natural Flow
				Average	Range		Average recurrence interval (years) 2	5	10	25	50	Maximum observed Date	Discharge	Unit Discharge (cfs/sq mi)	
09244500	Elkhead Creek near Clark, Colo.	45.4	1942-44, 1958-73	35.8	15.2-52.9	0.30-3.0	654	880	1,000	1,140	--	May 18, 1970	1,060	23.3	
09245000	Elkhead Creek near Elkhead, Colo.	64.2	1910;1920, 1953-	51.7	23.1-75.6	0-2.8	908	1,160	1,300	1,460	1,560	May 22, 1920	1,660 1/	25.9	
09245500	North Fork Elkhead Creek near Elkhead, Colo.	21	1910;1920 1958-73	17.2	8.24-27.9	0-0.67	402	652	837	1,090	--	May 21, 1970	1,100	52.4	Diversions above station for irrigation of about 100 acres of hay meadows.
09248600	East Fork of Williams Fork above Willow Creek, Colo.	108	1956-72	107	64.4-183	10-28	1,020	1,290	1,450	1,630	--	May 19, 1970	1,570	14.5	Diversions for irrigation of about 800 acres above station.
09249000	East Fork of Williams Fork near Pagoda, Colo.	150	1953-71	113	61.0-205	12-26	920	1,240	1,450	1,720	--	June 26, 1957	1,620	10.8	Diversions for irrigation of about 900 acres above station.
09249200	South Fork of Williams Fork near Pagoda, Colo.	46.7	1965-73	42.8	24.6-55.4	0.20-2.1	634	760	--	--	--	May 20, 1970	878	18.8	Diversions for irrigation of about 100 acres above and 50 acres below station.
09249500	Williams Fork at Hamilton Colo.	341	1904-6, 1909-27	219	141-396	---	1,930	2,530	--	--	--	June 10, 1917	3,400	10.0	Diversions for irrigation of about 4,500 acres above station. Small ditch imports water from nearby stream above station.
09250000	Milk Creek near Thornburgh, Colo.	65	1952-73	23.5	7.36-44.3	0.20-1.5	286	464	606	814	992	May 19, 1970	864	13.3	Diversions for irrigation of about 2,000 acres above station.
09253500	Battle Creek near Slater, Colo.	85.3	1942-51	83.	64.5-109	2.6-5.8	899	1,030	--	--	--	May 21, 1948	1,160	13.6	Diversions above station for irrigation of about 230 acres above and 70 acres below station.
09254500	Slater Fork at Baxter Ranch, near Slater, Colo.	80	1911-20, 1922	81.4	55.0-120	---	610	793	922	--	--	June 9, 1917	1,070	13.4	
09255000	Slater Fork near Slater, Colo.	161	1910-12, 1931-73	72.7	20.4-112	0-8.6	--	--	--	--	--	May 19, 1912	1,700	10.6	Diversions for irrigation of about 500 acres above station.
09255500	Savery Creek at upper station, near Savery, Wyo.	200	1940-44, 1952-72	45.0	18.4-76.1	0.60-12	460	837	1,140	1,590	1,970	Apr. 15, 1962	1,680	8.4	Diversions for irrigation of about 470 acres above station. Natural flow slightly affected by diversion above station to Platte River basin through Ranger ditch.
09256000	Savery Creek near Savery, Colo.	330	1941-46, 1947-72	104	39.7-207	0-14	--	--	--	--	--	May 4, 1952	2,670	8.1	Diversions for irrigation of about 640 acres above and 140 acres below station. Transbasin diversion above station.
0925700	Little Snake River near Dixon, Wyo.	988	1910-23, 1938-73	514	212-930	0.20-10	4,610	6,110	7,050	8,190	9,000	May 26, 1920	9,600	9.7	Diversions for irrigation of about 9,500 acres above and 3,000 acres below station. Transbasin diversion above station.
09258000	Willow Creek near Dixon, Wyo.	24	1953-73	9.38	4.79-15.5	0-1.3	131	200	245	300	339	May 6, 1970	267	11.1	Regulation by Elk Lake (capacity, 400 acre-ft).
09251000	Yampa River near Maybell, Colo.	3,410	1904-5, 1910-12, 1916-73	1,549	517-2 2,948	2-345	9,950	12,500	13,900	15,600	16,600	May 19, 1917	17,900	5.2	Natural flow of stream affected by trans-basin diversions, numerous storage reservoirs, and diversions above station for irrigation of about 65,000 acres above and 800 acres below station.

1/ Maximum daily discharge

TABLE V-13 (Cont.)

Streamflow Characteristics at Gaging Stations in Study Region

Station number	Station name	Drainage Area (sq mi)	Records Used (years)	Annual Mean Discharge (cfs)		Range of Annual Minimum Daily Discharge (cfs)	Peak Flows								Factors Affecting Natural Flow
				Average	Range		Average recurrence interval (years)					Maximum observed			
							2	5	10	25	50	Date	Discharge	Unit Discharge (cfs/sq mi)	
09251500	Middle Fork Little Snake River near Battle Creek, Colo.	120	1912-22	136	92.0-218	---	1,690	2,720	3,530	--	--	May 25, 1920	4,400	36.7	Diversions for irrigation of about 500 acres above station.
09251800	North Fork Little Snake River near Encampment, Wyo.	9.64	1956-65	25.7	20.0-34.7	1.1-2.2	--	--	--	--	--	June 7, 1957	515	53.4	Transbasin diversion above station to Hog Park Creek in Platte River basin for municipal, industrial, and irrigation uses.
09251900	North Fork Little Snake River near Slater, Colo.	29.3	1956-63	44.2	30.5-60.1	2.4-4.4	439	539	--	—	—	June 7, 1957	628	21.4	See remarks for station No. 09251800.
09252500	South Fork Little Snake River near Battle Creek, Colo.	46	1912-20	30.8	15.5-41.7	---	320	543	--	—	—	May 9, 1920	760	16.5	Diversions above station for irrigation of about 360 acres above and 80 acres below station.
09253000	Little Snake River near Slater, Colo.	285	1942-47, 1950-73	220	105-343	8.6-26	2,170	2,780	3,110	3,480	3,710	June 7, 1957	3,230	11.3	Natural flow of stream affected by transbasin diversions and diversions for irrigation of about 2,000 acres above station.
09259500	Fourmile Creek near Baggs, Wyo.	4	1911-23	6.56	3.77-14.2	---	82	132	163	--	--	June 9, 1917	168	42.0	Diversions above station for irrigation.
09259700	Little Snake River near Baggs, Wyo.	3,020	1961-68	523	261-771	0-13	4,620	6,610	--	--	--	Mar. 28, 1962	10,000	3.3	Diversions for irrigation of about 15,000 acres above station.
09260000	Little Snake River near Lily, Wyo.	3,730	1904, 1921-73	571	110-1,213	0-27	5,200	7,550	8,960	10,600	11,600	May 27, 1926	14,200	3.8	Diversions for irrigation of about 21,000 acres above station.
09302400	White River below Trappe Lake, Colo.	21.4	1956-65	27.8	19.0-42.2	2.9-9.6	--	--	--	--	--	July 4, 1957	481	22.5	Natural regulation by Trapper's Lake.
09302450	Lost Creek near Buford, Colo.	21.6	1964-73	22.3	12.6-28.1	0.8-1.9	--	--	--	--	--	May 18, 1970	818	37.9	
09302800	North Fork White River near Buford, Colo.	223	1903-6, 1956-73	290	201-402	85-150	1,340	1,630	1,790	1,960	--	June 8, 1905	1,950	8.7	Diversions above station for irrigation of a few hay meadows.
09303000	North Fork White River at Buford, Colo.	254	1910-15, 1919-20, 1951-73	311	221-550	90-180	1,400	1,910	2,250	2,680	3,000	May 30, 1912	3,150	12.4	Diversions above station for irrigation of about 900 acres above and 300 acres below station.
09303500	South Fork White River near Buford, Colo.	157	1903-6, 1910-15, 1942-47, 1967-73	263	202-351	60-90	1,740	2,200	2,500	2,890	--	June 17, 1906	3,230	20.6	Diversions for irrigation of about 600 acres of hay meadows above station.
09304000	South Fork White River at Buford, Colo.	170	1919-20, 1951-73	256	180-357	60-95	1,860	2,210	2,420	2,680	2,880	June 20, 1957	3,000	17.6	Diversions above station for irrigation of about 1,100 acres above and a few acres below stations.
09304100	Big Beaver Creek near Buford, Colo.	34.6	1955-64	14.9	5.92-29.6	0-0.6	205	297	--	--	--	June 3, 1957	395	11.4	One diversion above station for irrigation below station along the White River.
09304200	White River above Coal Creek, near Meeker, Colo.	660	1961-73	556	383-743	66-240	--	--	--	--	--	May 21, 1970	3,850	5.8	Diversions above station for irrigation of about 8,000 acres above and 4,000 acres below station.
09304300	Coal Creek near Meeker, Colo.	25	1957-68	5.23	2.78-9.51	0.40-1.2	51	80	99	—	--	May 11, 1958	102	4.1	Diversions for irrigation of a few acres of hay meadows above station.

TABLE V-13 (Cont.)

Streamflow Characteristics at Gaging Stations in Study Region

Station number	Station name	Drainage Area (sq mi)	Records Used (years)	Annual Mean Discharge (cfs)		Range of Annual Minimum Daily Discharge (cfs)	Peak Flows								Factors Affecting Natural Flow
							Average recurrence interval (years)					Maximum observed			
				Average	Range		2	5	10	25	50	Date	Discharge	Unit Discharge (cfs/sq mi)	
09304500	White River near Meeker, Colo.	762	1901-6, 1909-73	622	339-985	112-290	3,220	4,100	4,600	5,170	5,550	June 16, 1921	6,370	8.4	Diversions above station for irrigation of about 12,000 acres above and 3,000 acres below station.
09304800	White River below Meeker, Colo.	1,040	1961-73	625	454-791	141-300	--	--	--	--	--	June 15, 1965	4,010	3.9	Diversions above station for irrigation of about 22,000 acres above and a few acres below station.
09305500	Piceance Creek at Rio Blanco, Colo.	9	1952-57	1.40	0.77-2.55	0.10-0.30	12	19	--	—	—	May 9, 1957	23	2.6	Small diversions above station for irrigation of hay meadows above and below station.
09306200	Piceance Creek below Ryan Gulch, near Rio Blanco, Colo.	485	1964-73	16.6	8.30-29.1	0.21-6.0	139	221	--	--	—	Mar. 9, 1966	400	0.8	Diversions for irrigation above station.
09306500	White River near Watson, Utah	4,020	1904-6, 1918 1923-73	702	388-1,736	53-356	4,270	5,730	6,660	7,820	8,670	July 15, 1929	8,160	2.0	Diversions for irrigation of about 30,000 acres above station.

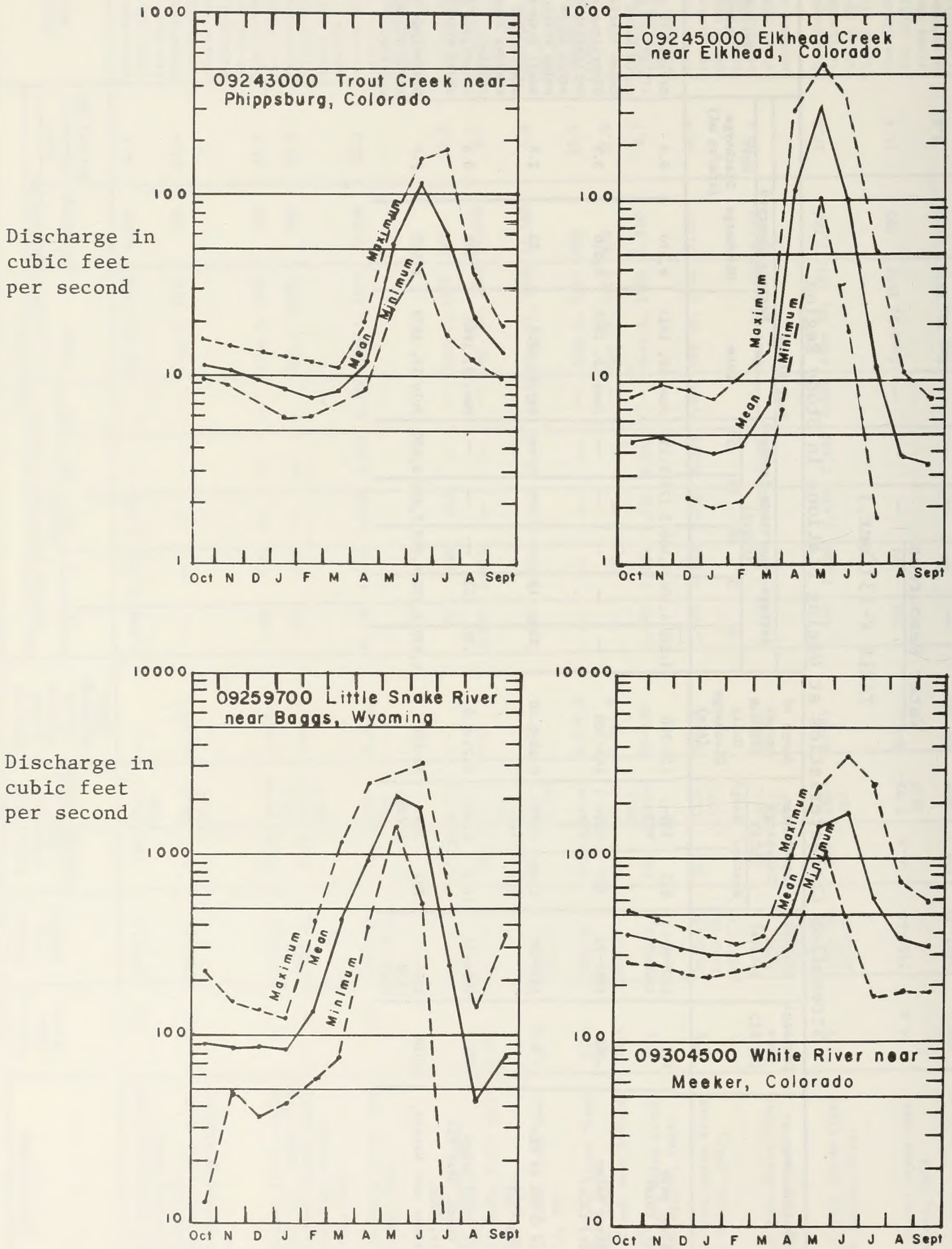
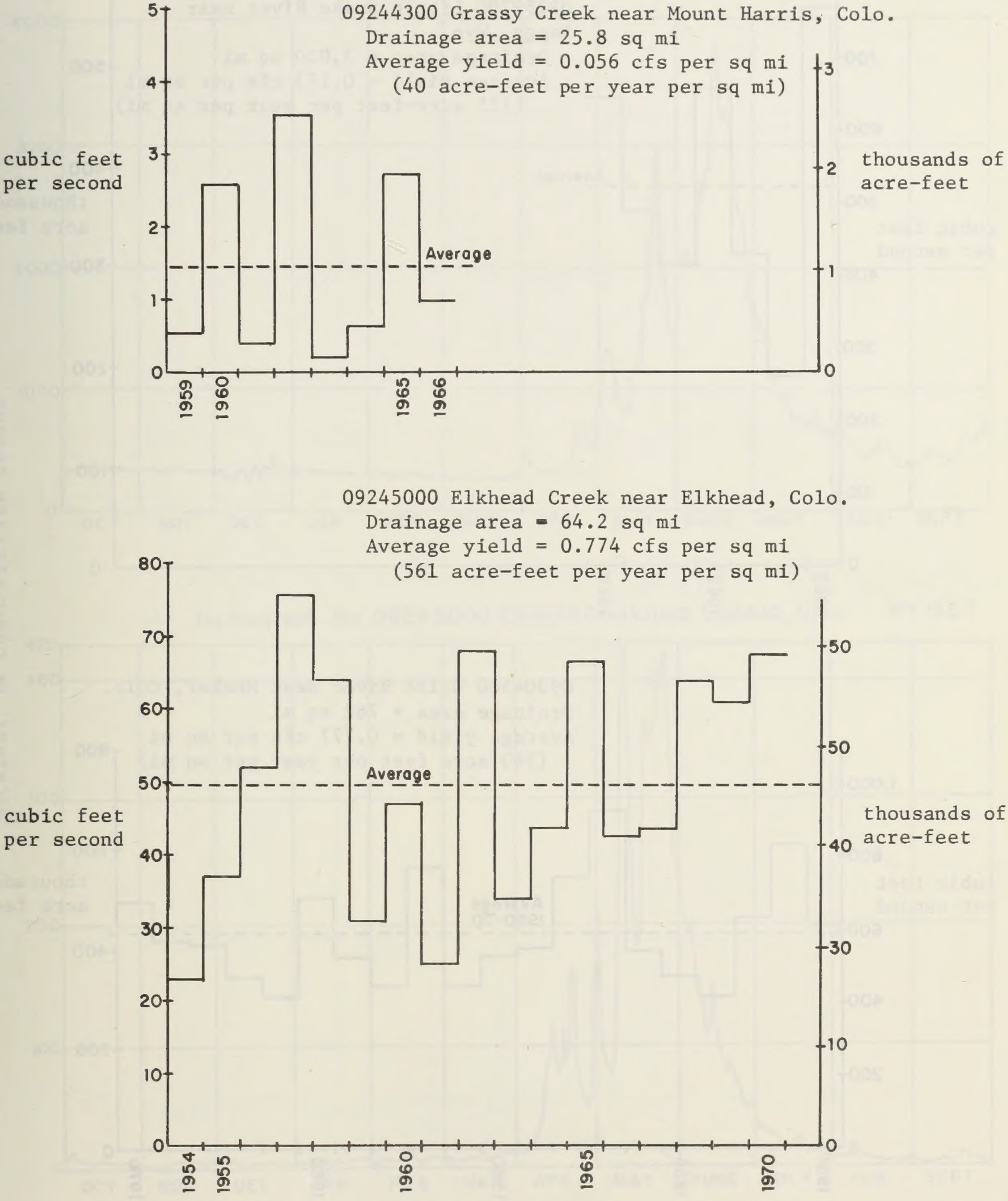


FIGURE V-1

Monthly hydrographs of selected streams in the study region.


09244300 Grassy Creek near Mount Harris, Colo.
Drainage area = 25.8 sq mi
Average yield = 0.056 cfs per sq mi
(40 acre-feet per year per sq mi)

09245000 Elkhead Creek near Elkhead, Colo.
Drainage area = 64.2 sq mi
Average yield = 0.774 cfs per sq mi
(561 acre-feet per year per sq mi)

FIGURE V-2

Yearly hydrographs of selected streams in the study region.

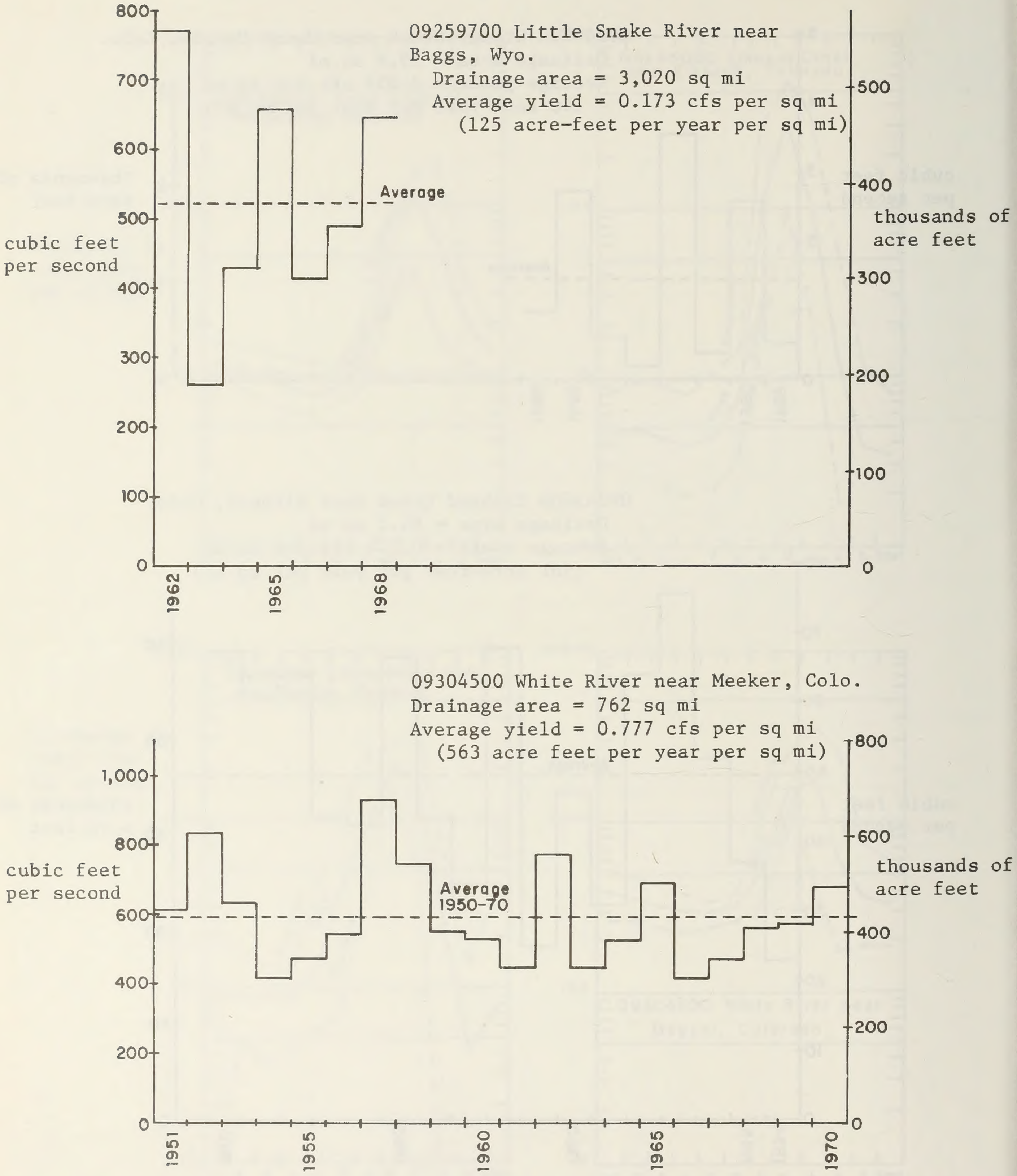


FIGURE V-2 (Cont'd)

Yearly hydrographs of selected streams in the study region.

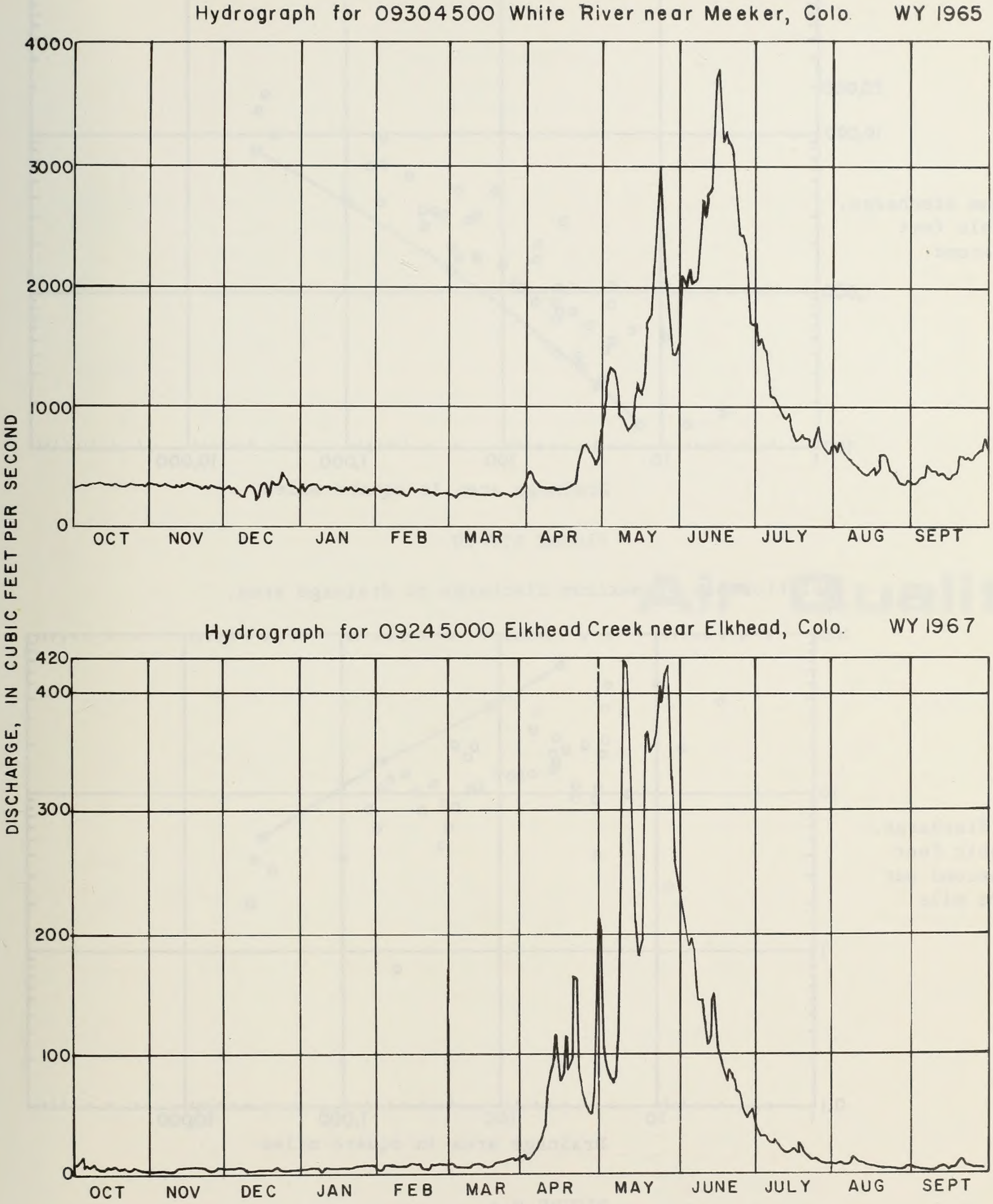


FIGURE V-3

Seasonal pattern of runoff in the Green River Basin.

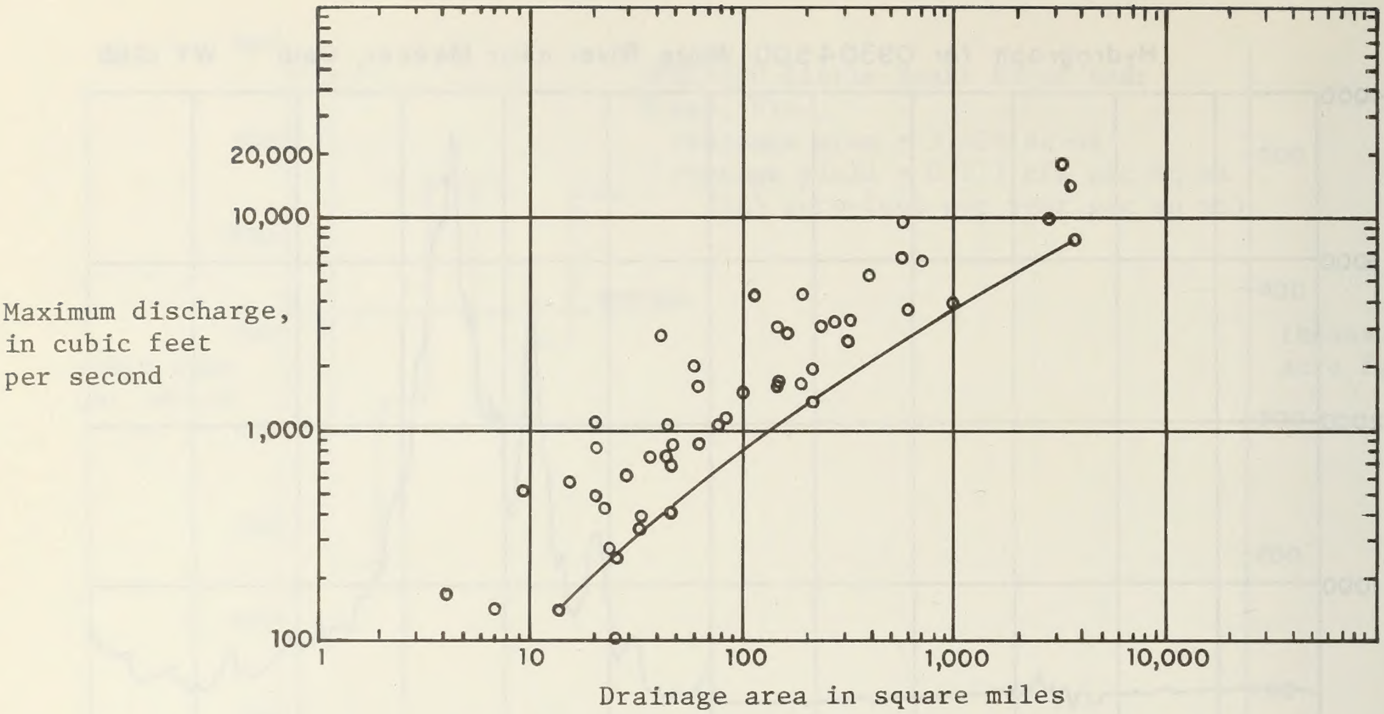


FIGURE RIV-10

Relationship of maximum discharge to drainage area.

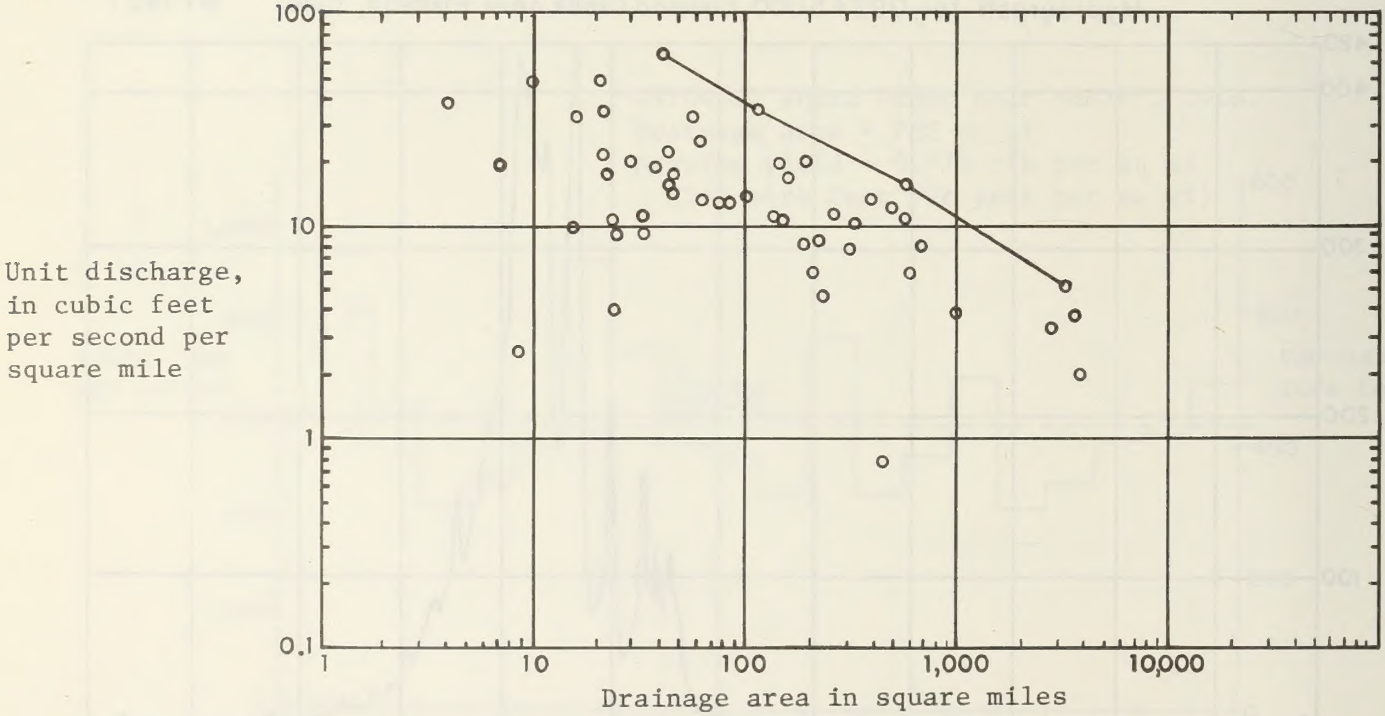


FIGURE V-4

Maximum observed unit discharge and envelope curve.

Air Quality

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Air Quality

Regional Emissions

Appendix D provides detailed tabulations of emissions from secondary fuel use, transportation systems, and mining activities in Routt, Rio Blanco, and Moffat Counties. Projected emissions for the years 1974, 1980, 1985, and 1990 are given by road link or area source. The size of the area sources and length of each road link are given as they were included in the computer model ERTAQ.

Figure VI-1 illustrates the 18 area sources into which secondary emissions from external fuel use were placed. Tables VI-1 through VI-4 show the projected emissions from each area for the four base years. The 1974 emissions were extracted from the National Emissions Data System (NEDS). Emissions for future years were computed by assuming a linear relationship between emissions and population.

Figure VI-2 illustrates the 14 highway links, 3 railway links, and 6 urban area sources for which vehicle exhaust emissions were computed. The proposed W. R. Grace Railway and the unpaved Seneca 2-W haul road are also shown. Vehicle exhaust emissions were computed using Environmental Protection Agency (EPA) emissions factors (1973a). Those for road traffic are shown in Table VI-5. Emissions from each link or urban area source are shown in Tables VI-6 through VI-9. The number of cars per day on each highway link in 1974 was extracted from a Colorado Department of Motor Vehicles traffic count. For the projection years, the traffic on each link was increased according to the regional population increase. Potential emissions from the urban area sources were computed by assuming that there were .6 cars/person in each town and that each car traveled 42 kilometers/day. Potential emissions from the railroads were computed using EPA (1973a) emissions factors for diesel locomotives. The results are shown in Table VI-10.

Potential emissions from materials handling at each mine required an estimate of quantity of materials that would be handled. Estimates of coal that would be mined, and topsoil and overburden that would be moved at each mine are shown in Table VI-11. Topsoil was assumed to be .3 meters deep at all surface mines, and the overburden stripping ratio was assumed to be 6 cubic yards/ton of coal, if an exact value was not known. Potential emissions from surface mines were computed using an emissions factor of .0055 percent of material that would be handled, derived from several reports on fugitive dust emissions (Cowherd, 1974; EPA, 1973; PEDCo, 1973). Potential fugitive dust emissions from underground mining were computed using an emissions factor of .0025 percent of coal mined. Potential emissions of fugitive dust as suspended particulate matter are shown in Table VI-12 for each mine.

Table VI-13 shows potential vehicle exhaust emissions from trucks and cars within each mine. They were computed from the EPA (1973a) emissions factors.

Potential suspended particulate emissions for unpaved roads were estimated by assuming that one kilogram is emitted/vehicle-kilometer traveled (PEDCo, 1973). This factor was applied to within-mine travel, and to the Seneca 2-W haul road.

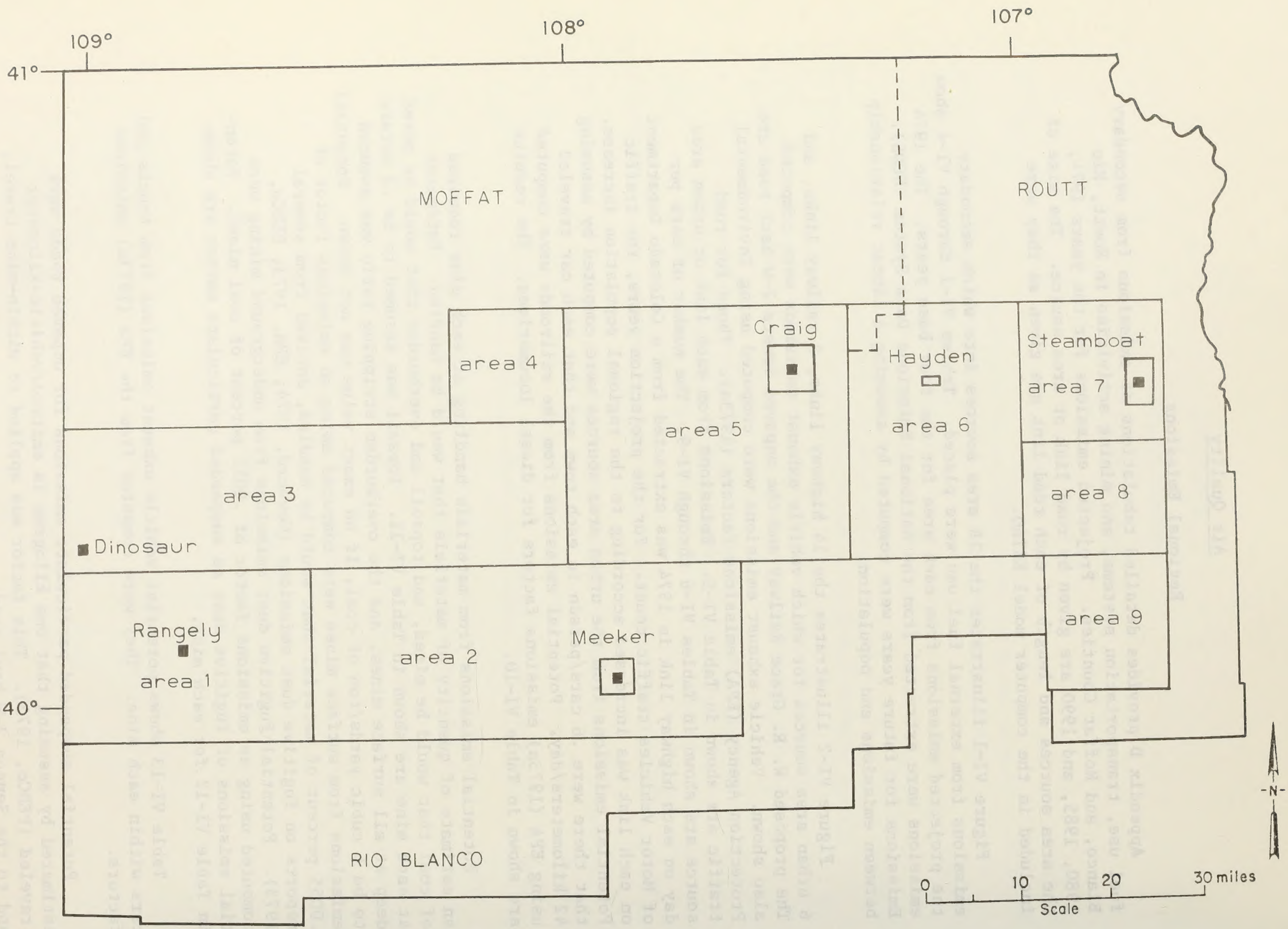


FIGURE VI-1

Areas for which emissions from external fuel consumption were estimated.

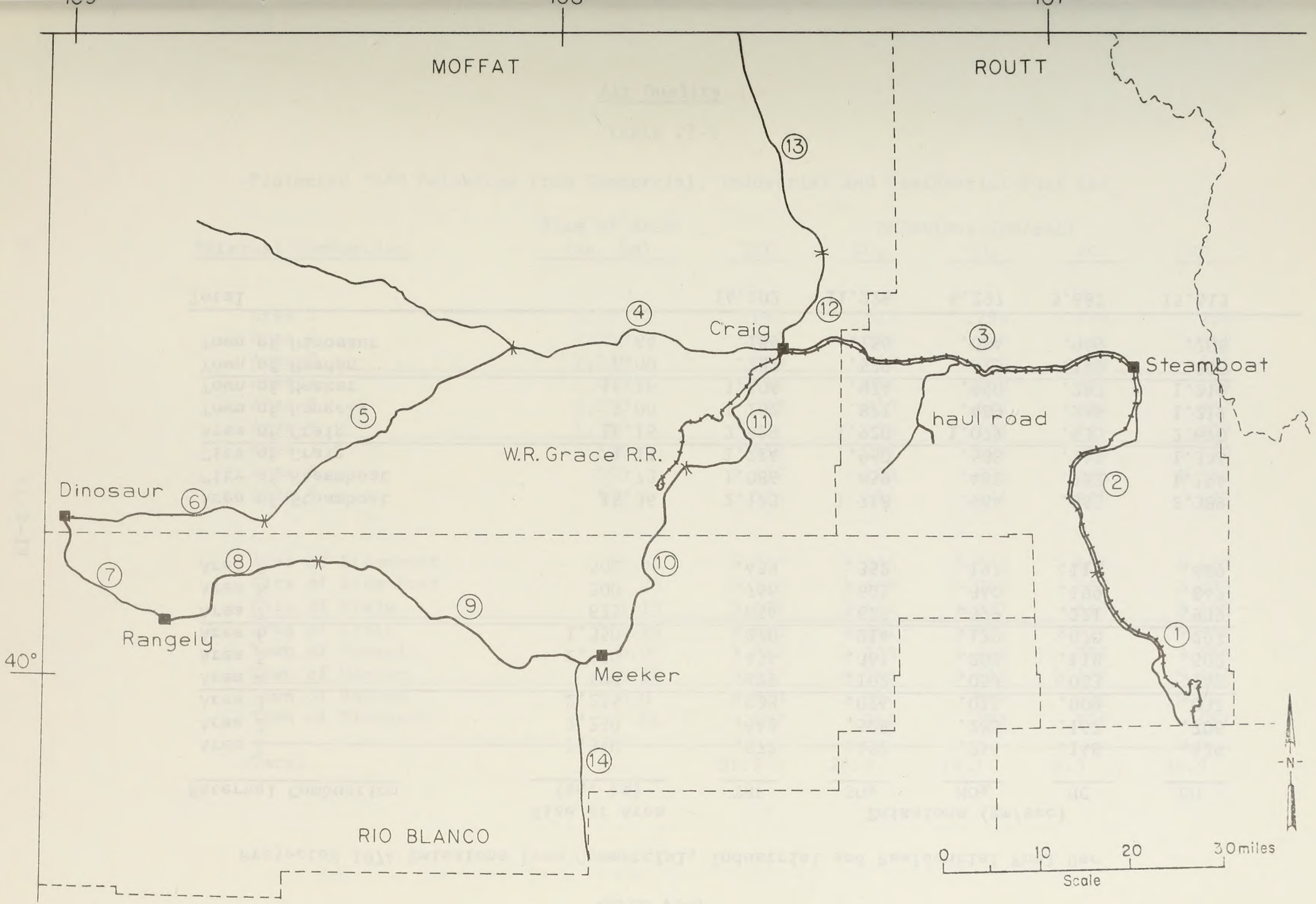


FIGURE VI-2

Road links, railroad links and urban areas for which vehicle emissions were estimated.

TABLE VI-1

Projected 1974 Emissions from Commercial, Industrial and Residential Fuel Use

External Combustion	Size of Area (sq. km)	Emissions (gm/sec) TSP	SOx	NOx	HC	CO
Area 1	1,350	.572	.452	.254	.148	.629
Area 2	2,250	.643	.508	.285	.167	.706
Area 3	2,225	.033	.026	.015	.009	.037
Area 4	400	.129	.102	.057	.033	.142
Area 5	2,250	.456	.361	.202	.118	.502
Area 6	1,350	.270	.214	.120	.070	.297
Area 7	625	.854	.675	.379	.221	.939
Area 8	500	.766	.605	.340	.199	.842
Area 9	500	.439	.352	.197	.115	.489
Area of Steamboat	15.36	2.173	1.718	.964	.563	2.389
City of Steamboat	.73	1.086	.859	.482	.282	1.194
City of Craig	1.13	1.214	.960	.538	.315	1.335
Area of Craig	16.16	2.429	1.920	1.077	.630	2.670
Town of Rangely	9.00	1.102	.871	.489	.286	1.212
Town of Meeker	16.16	1.106	.874	.490	.287	1.216
Town of Hayden	6.00	.732	.579	.325	.190	.805
Town of Dinosaur	.64	.189	.150	.084	.049	.208
Total		14.202	11.228	6.297	3.682	15.613

TABLE VI-2

Projected 1980 Emissions from Commercial, Industrial and Residential Fuel Use

External Combustion	Size of Area (sq. km)	Emissions (gm/sec) TSP	SO_x	NO_x	HC	CO
Area 1	1,350	.661	.522	.294	.173	.728
Area 2	2,250	.743	.586	.330	.194	.818
Area 3	2,225	.029	.023	.013	.008	.032
Area 4	400	.112	.088	.050	.029	.123
Area 5	2,250	.397	.313	.177	.104	.437
Area 6	1,350	.301	.238	.134	.079	.332
Area 7	625	.953	.752	.424	.429	1.049
Area 8	500	1.437	1.133	.639	.376	1.582
Area 9	500	.525	.414	.234	.138	.578
Area of Steamboat	15.36	4.230	3.336	1.882	1.108	4.657
City of Steamboat	.73	2.115	1.668	.941	.554	2.329
City of Craig	1.13	3,095	2.441	1.377	.810	3.408
Area of Craig	16.16	6.190	4.881	2.753	1.621	6.814
Town of Rangely	9.0	3.012	2.375	1.340	.789	3.316
Town of Meeker	16.16	5.437	4.288	2.418	1.424	5.986
Town of Hayden	6.0	2.020	1.59	.899	.529	2.22
Town of Dinosaur	.64	.442	.349	.197	.116	.487
Total		31.7	25.0	14.1	8.3	34.9

TABLE VI-3

Projected 1985 Emissions from Commercial, Industrial and Residential Fuel Use

External Combustion	Size of Area (sq. km)	Emissions (gm/sec)				
		TSP	SO_x	NOx	HC	CO
Area 1	1,350	.776	.612	.345	.203	.853
Area 2	2,250	.871	.688	.387	.228	.957
Area 3	2,225	.034	.027	.015	.009	.037
Area 4	400	.132	.105	.059	.035	.146
Area 5	2,250	.467	.369	.208	.122	.514
Area 6	1,350	.536	.424	.238	.140	.590
Area 7	625	1.699	1.342	.756	.444	1.869
Area 8	500	1.731	1.367	.770	.453	1.903
Area 9	500	.605	.478	.269	.158	.665
Area of Steamboat	15.36	4.928	3.892	2.192	1.288	5.419
City of Steamboat	0.73	2.464	1.946	1.096	.644	2.710
City of Craig	1.13	2.750	2.172	1.223	.719	3.024
Area of Craig	16.16	5.500	4.343	2.446	1.438	6.048
Town of Rangely	9.00	4.338	3.426	1.929	1.134	4.771
Town of Meeker	16.16	8.007	6.324	3.561	2.094	8.806
Town of Hayden	6.00	1.512	1.194	.673	.395	1.663
Town of Dinosaur	2.56	.749	.592	.333	.196	.824
Total		37.1	29.3	16.5	9.7	40.8

TABLE VI-4

Projected 1990 Emissions from Commercial, Industrial and Residential Fuel Use

External Combustion	Size of Area (sq. km)	Emissions (gm/sec) TSP	SO_x	NO_x	HC	CO
Area 1	1,350	.928	.730	.412	.242	1.019
Area 2	2,250	1.042	.820	.462	.272	1.144
Area 3	2,225	.043	.034	.019	.011	.047
Area 4	400	.164	.129	.073	.043	.180
Area 5	2,250	.580	.456	.257	.151	.637
Area 6	1,350	.552	.435	.245	.144	.606
Area 7	625	1.750	1.377	.776	.456	1.921
Area 8	500	1.827	1.438	.810	.476	2.006
Area 9	500	.686	.540	.304	.179	.753
Area of Steamboat	15.36	5.123	4.031	2.272	1.335	5.623
City of Steamboat	0.73	2.561	2.015	1.136	.668	2.811
City of Craig	1.13	3.266	2.570	1.449	.851	3.585
Area of Craig	16.16	6.532	5.141	2.898	1.703	7.171
Town of Rangely	9.00	3.939	3.100	1.748	1.027	4.324
Town of Meeker	16.16	8.535	6.716	3.786	2.225	9.369
Town of Hayden	6.00	1.719	1.353	.762	.448	1.887
Town of Dinosaur	2.56	.652	.513	.289	.170	.716
Total		39.9	31.4	17.7	10.4	43.8

TABLE VI-5

Emissions Factors Used to Develop Road
Vehicle Emissions in the Tri-County Area, (gm/km)

Year	TSP		SO_2		NO_2		HC		CO	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1974	.36	.36	.12	.12	3.2	4.2	4.5	2.7	46.6	23.8
1980	.36	.36	.12	.12	1.9	2.5	1.5	.9	.14	7.0
1985	.36	.36	.12	.12	1.9	2.5	1.5	.9	.14	7.0
1990	.36	.36	.12	.12	1.4	1.8	.99	.60	8.7	4.4

TABLE VI-6

Projected Vehicle Emissions from 1974 Road Travel
in the Tri-County Study Area

Road Emissions	Vehicles per day (1974)	Length (km)	Emissions (gm/sec)				
			TSP	SO_x	NO_x	HC	CO
Line Sources							
Link 1	400	30	.050	.017	.583	.375	3.306
Link 2	750	32	.100	.033	1.167	.750	6.611
Link 3	1,950	48	.390	.130	4.550	2.925	25.783
Link 4	1,100	46	.211	.070	2.460	1.581	13.938
Link 5	920	51	.196	.065	2.281	1.466	12.925
Link 6	920	29	.111	.037	1.297	.834	7.349
Link 7	660	24	.066	.022	.770	.495	4.363
Link 8	400	22	.037	.012	.428	.275	2.424
Link 9	400	46	.077	.026	.894	.575	5.069
Link 10	700	35	.102	.034	1.191	.766	6.749
Link 11	900	25	.094	.031	1.094	.703	6.198
Link 12	900	15	.056	.019	.656	.422	3.719
Link 13	550	41	.094	.031	1.096	.705	6.212
Link 14	850	34	.120	.040	1.405	.903	7.961
Area Sources							
Area of Steamboat	2,983	42	.522	.174	4.640	6.525	67.573
Area of Craig	3,334	42	.583	.194	5.186	7.293	75.524
Town of Meeker	1,012	42	.177	.059	1.574	2.214	22.925
Town of Rangely	1,009	42	.177	.059	1.570	2.207	22.857
Town of Dinosaur	173	42	.030	.010	.269	.378	3.919
Town of Hayden	670	42	.117	.039	1.042	1.466	15.177

TABLE VI-7

Projected Vehicle Emissions from 1980 Road Travel in the Tri-County Study Area

Road Emissions	Vehicles per day (1980)	Length (km)	Emissions (gm/sec)				
			TSP	SO_x	NO_x	HC	CO
Line Sources							
Link 1	890	30	.111	.037	.773	.278	2.163
Link 2	1,680	32	.224	.075	1.556	.560	4.356
Link 3	4,360	48	.872	.291	6.056	2.180	16.956
Link 4	2,460	46	.472	.157	3.274	1.179	9.168
Link 5	2,060	51	.438	.146	3.040	1.094	8.512
Link 6	2,060	29	.249	.083	1.729	.622	4.840
Link 7	1,470	24	.147	.049	1.021	.368	2.858
Link 8	890	22	.082	.027	.567	.204	1.586
Link 9	890	46	.171	.057	1.185	.426	3.317
Link 10	1,560	35	.228	.076	1.580	.569	4.424
Link 11	2,010	25	.209	.070	1.454	.523	4.071
Link 12	2,010	15	.126	.042	.872	.314	2.443
Link 13	1,230	41	.210	.070	1.459	.525	4.086
Link 14	1,900	34	.269	.090	1.869	.673	5.234
Area Sources							
Area of Steamboat	5,813	42	1.017	.339	5.369	4.239	39.561
Area of Craig	8,506	42	1.489	.496	7.856	6.202	57.888
Town of Meeker	4,981	42	.872	.291	4.601	3.632	33.898
Town of Rangely	2,759	42	.483	.161	2.548	2.012	18.777
Town of Dinosaur	405	42	.071	.024	.374	.295	2.756
Town of Hayden	1,255	42	.220	.073	1.159	.915	8.541
Seneca - Ruby Haul Road		25	24.10	.089	1.297	.239	1.367

TABLE VI-8

Projected Vehicle Emissions from 1985 Road Travel in the Tri-County Study Area

Road Emissions	Vehicles per day (1985)	Length (km)	Emissions (gm/sec)				
			TSP	SO_x	NO_x	HC	CO
Line Sources							
Link 1	1,050	30	.131	.044	.911	.328	2.552
Link 2	1,960	32	.261	.087	1.815	.653	5.081
Link 3	5,090	48	1.018	.339	7.069	2.545	19.794
Link 4	2,870	46	.550	.183	3.820	1.375	10.696
Link 5	2,400	51	.510	.170	3.542	1.275	9.917
Link 6	2,400	29	.290	.097	2.014	.725	5.639
Link 7	1,720	24	.172	.057	1.194	.430	3.344
Link 8	1,050	22	.096	.032	.668	.241	1.872
Link 9	1,050	46	.201	.067	1.398	.503	3.913
Link 10	1,830	35	.267	.089	1.853	.667	5.189
Link 11	2,350	25	.245	.082	1.700	.612	4.760
Link 12	2,350	15	.147	.049	1.020	.367	2.856
Link 13	1,440	41	.246	.082	1.708	.615	4.783
Link 14	2,220	34	.315	.105	2.184	.786	6.115
Area Sources							
Area of Steamboat	6,766	42	1.184	.395	6.249	4.934	46.046
Area of Craig	7,550	42	1.321	.440	6.973	5.505	51.382
Town of Meeker	7,328	42	1.282	.427	6.768	5.343	49.871
Town of Rangely	3,970	42	.695	.232	3.667	2.895	27.018
Town of Dinosaur	686	42	.120	.040	.634	.500	4.669
Town of Hayden	2,142	42	.375	.125	1.978	1.562	14.578
Seneca - Ruby Haul Road		25	24.100	.089	1.297	.239	1.367

TABLE VI-9

Projected Vehicle Emissions from 1990 Road Travel in the Tri-County Study Area

Road Emissions	Vehicles per day (1990)	Length (km)	Emissions (gm/sec)				
			TSP	SO_x	NO_x	HC	CO
Line Sources							
Link 1	1,120	30	.140	.047	.700	.233	1.711
Link 2	2,110	32	.281	.094	1.407	.469	3.439
Link 3	5,480	48	1.096	.365	5.480	1.827	13.396
Link 4	3,090	46	.592	.197	2.961	.987	7.239
Link 5	2,580	51	.548	.183	2.741	.914	6.701
Link 6	2,580	29	.312	.104	1.559	.520	3.810
Link 7	1.850	24	.185	.062	.925	.308	2.261
Link 8	1,120	22	.103	.034	.513	.171	1.255
Link 9	1,120	46	.215	.072	1.073	.358	2.624
Link 10	1,970	35	.287	.096	1.436	.479	3.511
Link 11	2,530	25	.264	.088	1.318	.439	3.221
Link 12	2,530	15	.158	.053	.791	.264	1.933
Link 13	1,540	41	.263	.088	1.315	.438	3.215
Link 14	2,390	34	.339	.113	1.693	.564	4.138
Area Sources							
Area of Steamboat	7,028	42	1.230	.410	4.783	3.382	29.723
Area of Craig	8,962	42	1.568	.523	6.099	4.313	37.902
Town of Meeker	7,806	42	1.366	.455	5.312	3.757	33.013
Town of Rangely	3,603	42	.631	.210	2.452	1.734	15.238
Town of Dinosaur	596	42	.104	.035	.406	.287	2.521
Town of Hayden	2,239	42	.392	.131	1.524	1.078	9.469
Seneca - Ruby Haul Road		25	24.100	.089	1.297	.239	1.367

TABLE VI-10

Projected Emissions from Railroads in the Tri-County Region (gm/sec)

Railroad	Number of Trains/Day	TSP	SO_x	NO_x	HC	CO
D & RGW R.R.						
1974	3	.23	0.5	3.2	0.8	1.1
1980	13	1.0	3.1	13.8	3.5	4.9
W.R. Grace R.R.						
1980	1	.02	0.06	0.4	0.1	0.1

TABLE VI-11

Quantity of Material That Would Be Handled (metric tons per year*) At Each Coal Mine Included in the Regional Impact Statement

Mines	Present			1980		
	Coal Production	Over-burden	Topsoil	Coal Production	Over-burden	Topsoil
W. R. Grace	0	0	0	2.72	24.38	.32
Seneca 2-W	0	0	0	.82	6.45	.13
Energy 1	1.13	17.98	.16	2.25	35.96	.43
Energy 2	.52	4.67	.07	1.11	9.93	.41
Energy 3	0	0	0	1.18	16.03	.35
Utah International	0	0	0	2.61	47.54	.41
Edna	.09	9.56	.13	1.00	10.52	.14
Seneca 2	.54	5.74	.08	.54	5.74	.08
Empire Energy	.27	2.87	.04	.27	2.87	.04
Paul Coupey	0	0	0	.91	9.56	.13
Moonlake	0	0	0	1.36	14.34	.19
Routt Mining	0	0	0	.18	1.91	.03
Ruby (U)	0	-	-	.18	--	--
Apex (U)	.01	-	-	.03	--	--
Reinau (U)	.01	-	-	.27	--	--
Coal Fuels (U)	0	-	-	1.82	--	--
Aggregate for Merchants, Woodward and Consolidated Coal	0	0	0	3.81	38.24	.51

* 1 metric ton = 1.1016 short tons.

U Indicates underground mining.

TABLE VI-11 (Cont.)

Quantity of Material That Would Be Handled (metric tons per year*) At Each Coal Mine Included in the Regional Impact Statement

Mines	1985 Coal Production	1985 Over-burden	1985 Topsoil	1990 Coal Production	1990 Over-burden	1990 Topsoil
W. R. Grace	2.72	24.38	.32	2.72	24.38	.32
Seneca 2-W	.82	6.45	.13	.82	6.45	.13
Energy 1	2.25	35.96	.43	2.25	35.96	.43
Energy 2	1.11	9.93	.41	1.11	9.93	.41
Energy 3	1.18	16.03	.35	1.18	16.03	.35
Utah International	2.61	47.54	.41	2.61	47.54	.41
Edna	1.04	10.99	.15	.36	3.82	.05
Seneca	.54	5.74	.08	.54	5.74	.08
Empire Energy	.27	2.87	.04	.36	3.82	.05
Paul Coupey	.91	9.56	.13	.91	9.56	.13
Moonlake	2.09	21.99	.29	3.36	35.37	.47
Routt Mining	.27	2.87	.04	.27	2.87	.04
Ruby (U)	.18	--	--	.18	--	--
Apex (U)	.04	--	--	.04	--	--
Reinau (U)	.27	--	--	.36	--	--
Coal Fuels (U)	1.82	--	--	1.82	--	--
Aggregate for Merchants, Woodward and Consolidation Coal	3.81	38.24	.51	3.81	38.24	.51

* 1 metric ton = 1.1016 short tons.

U Indicates underground mining.

Air Quality

TABLE VI-12

Projected Suspended Particulate Emissions from Materials Handling

Mine	Emissions (gm/sec) Present	1980	1985	1990	Emission Per Unit Area (gm/m^2 sec)
W. R. Grace	0	20.54	20.54	20.54	3.76×10^{-5}
Seneca 2W	0	5.54	5.54	5.54	2.49×10^{-5}
Energy 1	14.43	28.94	28.94	28.94	3.95×10^{-5}
Energy 2	3.95	8.58	8.58	8.58	1.23×10^{-5}
Energy 3	0	13.16	13.16	13.16	2.18×10^{-5}
Utah International	0	37.89	37.89	37.89	5.38×10^{-5}
Edna	7.94	8.73	9.13	3.18	3.64×10^{-5}
Seneca 2	4.76	4.76	4.76	4.76	2.87×10^{-5}
Empire Energy	2.38	2.38	2.38	3.18	2.91×10^{-5}
Paul Coupey	0	7.94	7.94	7.94	2.89×10^{-5}
Moonlake	0	11.91	18.26	29.37	3.63×10^{-5}
Routt Mining	0	1.59	2.38	2.38	2.94×10^{-5}
Ruby (U)	0	.14	.14	.14	1.73×10^{-5}
Apex (U)	.01	.02	.03	.03	$.74 \times 10^{-5}$
Reinau (U)	.01	.21	.21	.29	2.55×10^{-5}
Coal Fuels (U)	0	1.44	1.44	1.44	4.24×10^{-5}
Total	33.48	185.77	193.32	199.27	
Aggregate for Merchants, Woodward and Consolidation Coal	0	31.89	31.89	31.89	6.00×10^{-5}

U Indicates underground mining.

TABLE VI-13

Within Mine Vehicle Emissions (metric tons/year)

Mines	Number of Gasoline Powered Vehicles	Haul Truck Capability (metric tons)	Haulage Trips Per Day	TSP		SO_x		NO_x		HC		CO	
				Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks
W. R. Grace	244	91	82	.121	.089	.029	.180	1.140	2.514	1.461	.251	7.837	1.520
Seneca 2-W	44	23	98	.022	.106	.005	.215	.206	3.005	.263	.300	1.413	1.817
Energy 1	294	23	268	.146	.290	.035	.587	1.374	8.217	1.760	.822	9.443	4.969
Energy 2	145	23	132	.072	.143	.017	.289	.677	4.047	.868	.405	4.657	2.448
Energy 3	154	23	141	.076	.152	.018	.309	.719	4.323	.922	.432	4.946	2.614
Utah International	190	68	105	.094	.113	.022	.230	.888	3.219	1.137	.322	6.103	1.947
Edna	75	23	119	.037	.129	.009	.261	.350	3.649	.449	.365	2.409	2.206
Seneca 2	50	23	64	.025	.069	.006	.140	.234	1.962	.299	.196	1.606	1.187
Empire Energy	30	23	32	.015	.035	.004	.070	.140	.981	.180	.098	.964	.593
Paul Coupey	80	23	108	.040	.117	.009	.237	.374	3.311	.479	.331	2.570	2.002
Moonlake	746	91	41	.370	.044	.088	.090	3.485	1.257	4.466	.126	23.962	.760
Other Mines	530	23-91	120	.263	.141	.063	.285	2.476	3.986	3.173	.398	17.024	2.410
Total				1.281	1.428	.305	2.893	12.063	40.471	15.457	4.046	82.934	24.473

* 1 metric ton = 1.1016 short tons.

Site Specific Emissions

Introduction

Potential emissions of air pollutants from the various sources at each mine are calculated using a uniform methodology. First, an emission factor for each pollutant from each source is developed from referenced studies, and altered to best apply to individual mine characteristics. The term "emission factor" means the quantity of air pollutant generated by a source per unit of source operation. The unit of quality used is mass of pollutant. Source operation units include vehicle miles, mass of material handled, and mass of coal produced.

Potential emissions have been categorized in terms of: (1) fugitive dusts from the mining operation, including material handling and storage, (2) fugitive dust from use of off-mine roads, and (3) fugitive dusts from processing, including material transport, and crushing or grinding, and (4) vehicle exhaust. Emission factors are applied to individual sources by simply multiplying the source operation rate by the appropriate emission factor (and any other factor designed to take special conditions into account). All emissions have been calculated on an annual basis to allow for smoothing of day-to-day fluctuations. Emissions are thus given in terms of mass/year.

To indicate the exact formulas of calculation, Table VI-14 has been prepared. All equations used to compute emissions have been included. Parameters, symbols, units, and numerical values are specified in Table VI-15. Subsequent text describes in detail the derivations, calculations, and approximations used for each source.

Fugitive dust

Potential fugitive dust emissions from the mining activities of handling topsoil, overburden, and coal have been calculated separately, but consistently. Emissions factors for topsoil dust, F_{13}, overburden dust, F_{14}, and coal dust, F_{15}, were obtained by applying the work of Cowherd (1974) to the mining of coal. In that study, emission factors for mass of particulates that will become and remain airborne, per mass of handled material, were obtained by measurements of emissions from the removal and storage of aggregate. Particles greater than 30 micrometers in diameter were assumed to settle out of the atmosphere in short distances, and were not considered. Since the material moved at the mine would not be aggregate, but coarse broken rock containing few fine particles, emission factors were reduced by a factor of three, over those recommended by EPA (1973) to describe the effects of crushing on aggregate. Emission factors developed by the methodology of Cowherd (1974) include a breakdown of 12 percent contribution from storage pile formation, 40 percent from vehicular traffic, 33 percent from wind erosion, and 15 percent from redistribution or loading of material.

TABLE VI-14

Formulas for Calculating Emissions

Constants are conversion factors

Fugitive Dust - Off-Mine Roads

$$E_1 = CMF_1 \left(\frac{D_1 P}{A_1} + ND_2 U\right) (10^{-3})$$

Vehicle Emissions - Within Mine

Trucks

$$E_3 = \frac{PD_3}{A_2} F_3 (10^{-6})$$

$$E_5 = \frac{PD_3}{A_2} F_5 (10^{-6})$$

$$E_7 = \frac{PD_3}{A_2} F_7 (10^{-6})$$

$$E_9 = \frac{PD_3}{A_2} F_9 (10^{-6})$$

$$E_{11} = \frac{PD_3}{A_2} F_{11} (10^{-6})$$

Cars

$$E_4 = ND_4UF_4 (10^{-6})$$

$$E_6 = ND_4UF_6 (10^{-6})$$

$$E_8 = ND_4UF_8 (10^{-6})$$

$$E_{10} = ND_4UF_{10} (10^{-6})$$

$$E_{12} = ND_4UF_{12} (10^{-6})$$

Fugitive Dust - Mining

$$E_{13} = CTL_1S_1 F_{13}$$

$$E_{14} = CTL_2S_2 F_{14}$$

$$E_{15} = CTL_3S_3 F_{15}$$

Vehicle Emissions - Off-Mine

Trucks

$$E_{17} = \frac{PD_1}{A_1} F_3 (10^{-6})$$

$$E_{19} = \frac{PD_1}{A_1} F_5 (10^{-6})$$

$$E_{21} = \frac{PD_1}{A_1} F_7 (10^{-6})$$

$$E_{23} = \frac{PD_1}{A_1} F_9 (10^{-6})$$

$$E_{25} = \frac{PD_1}{A_1} F_{11} (10^{-6})$$

Cars

$$E_{18} = ND_2UF_4 (10^{-6})$$

$$E_{20} = ND_2UF_6 (10^{-6})$$

$$E_{22} = ND_2UF_8 (10^{-6})$$

$$E_{24} = ND_2UF_{10} (10^{-6})$$

$$E_{26} = ND_2UF_{12} (10^{-6})$$

Process

$$E_{16} = P F_{16} (10^{-3})$$

TABLE VI-15

Definitions and Numerical Values of Emission Calculation Parameters

Definition	Symbol	Units	Numerical Value for Site Specifics Grace/Colowyo	Seneca 2W	Energy Fuels 1	2	3	Ruby	Source
Coal Production Rate	P	metric tons/yr x 10^6	2.7	0.82	2.2	1.1	1.2	0.18	Mine Plans
Number of Employees	[illegible]	----	244	43	294	145	154	45	Mine Plans
Area of Distrubed Land	T	km^2/year	0.55	0.22	0.73	0.70	0.60	NA	Mine Plans
Average Depth of Topsoil	L_1	meters	0.30	0.30	0.30	0.30	0.30	NA	Mine Plans
Average Depth of Overburden	L_2	meters	21	14	23	6.8	13	NA	Mine Plans
Average Coal Seam Thickness	L_3	meters	3.7	2.9	2.3	1.2	1.5	NA	Mine Plans
Average Stripping Ratio	R	cu yd/ton	5.1	4.5	9.1	5.1	7.8	NA	Mine Plans
Density of Topsoil	S_1	kg/m_3	1400	1400	1400	1400	1400	NA	Mine Plans
Density of Overburden	S_2	kg/m_3	2000	2000	2000	2000	2000	NA	Mine Plans
Density of Coal	S_3	kg/m_3	1300	1300	1300	1300	1300	NA	Mine Plans
Haulage Truck Capacity, off-mine	A_1	metric tons	23	23	NA	NA	NA	23	Mine Plans
Haulage Truck Capacity, within mine	A_2	metric tons	91	23	23	23	23	23	Mine Plans
Fraction of Dry, Snowless Days	C	---	0.44	0.43	0.43	0.43	0.43	0.51	Table 1
Number of Days in Year Worked	U	days	250	250	250	250	250	250	Mine Plans
Round-Trip Haulage Distances									
Off-mine, trucks	D_1	km	50	30	0	0	0	50	Mine Plans
Off-mine, cars	D_2	km	50	33	50	50	50	50	Mine Plans
Within mine, trucks	D_3	km	3	4	6	4	2	0	Mine Plans
Within mine, cars	D_4	km	4	4	6	4	2	0	Mine Plans
Fraction of Off-Mine Road Unpaved	Y	----	0	0.3	0.3	0.3	0.3	1	Mine Plans
Road Fugitive Dust Emission Factor	F_1	kg/km	1	1	1	1	1	1	(PEDCo, 1973)

---

* 1 metric ton = 1.1016 short ton
NA Not applicable

Air Quality

TABLE VI-15 (Cont.)

Definitions and Numerical Values of Emission Calculation Parameters

Definition	Symbol	Units	Numerical Value for Site Specifics						
					Energy Fuels				
			Grace/Colowyo	Seneca 2W	1	2	3	Ruby	Source
OFF-MINE									
Vehicle Exhaust Emission Rates									
Nitrogen Oxides, trucks	E_{23}	metric tons/year	120.	28.	0	0	0	10.	Calculated
Nitrogen Oxides, cars	E_{24}	metric tons/year	9.7	1.1	11.8	5.8	6.2	1.8	Calculated
Sulfur Oxides, trucks	E_{25}	metric tons/year	8.7	2.0	0	0	0	0.75	Calculated
Sulfur Oxides, cars	E_{26}	metric tons/year	0.24	0.029	0.30	0.15	0.16	0.045	Calculated
WITHIN MINE									
Fugitive Dust Uncontrolled									
Emission Rate, Topsoil	E_{13}	metric tons/year	5.6	2.2	6.4	7.0	6.0	NA	Calculated
Overburden	E_{14}	metric tons/year	560.	150.	800.	220.	370.	NA	Calculated
Coal	E_{15}	metric tons/year	64.	20.	51.	26.	20.	NA	Calculated
Vehicle Exhaust Emission Rates									
Particulates, trucks	E_3	metric tons/year	0.066	0.11	0.42	0.14	0.077	0	Calculated
Particulates, cars	E_4	metric tons/year	0.033	0.015	0.15	0.042	0.026	0	Calculated
Hydrocarbons, trucks	E_5	metric tons/year	0.19	0.31	1.2	0.40	0.22	0	Calculated
Hydrocarbons, cars	E_6	metric tons/year	1.0	0.18	1.0	0.58	0.32	0	Calculated
Carbon Monoxide, trucks	E_7	metric tons/year	4.5	0.42	7.2	2.4	1.3	0	Calculated
Carbon Monoxide, cars	E_8	metric tons/year	5.4	0.97	9.8	3.2	1.71	0	Calculated
Nitrogen Oxides, trucks	E_9	metric tons/year	1.9	3.1	12.	4.0	2.2	0	Calculated
Nitrogen Oxides, cars	E_{10}	metric tons/year	0.77	0.14	1.4	0.45	0.24	0	Calculated
Sulfur Oxides, trucks	E_{11}	metric tons/year	0.13	0.22	0.65	0.22	0.16	0	Calculated
Sulfur Oxides, cars	E_{12}	metric tons/year	0.020	0.0036	0.037	0.012	0.0062	0	Calculated
Process Particulate Emission Rate, Controlled	E_{16}	metric tons/year	68.	NA	55.	28.	20.	4.5	Calculated

Air Quality

TABLE VI-15 (Cont.)

Definitions and Numerical Values of Emission Calculation Parameters

Definition	Symbol	Units	Grace/Colowyo	Seneca II	Energy Fuels 1	Energy Fuels 2	Energy Fuels 3	Ruby	Source
			Numerical Value for Site Specifics						
Vehicle Exhaust Emission Factors									
Particulates, trucks	F_3	gm/km	0.74	0.74	0.74	0.74	0.74	0.74	EPA, 1973
Particulates, cars	F_4	gm/km	0.34	0.34	0.34	0.34	0.34	0.34	EPA, 1973
Hydrocarbons, trucks	F_5	gm/km	2.1	2.1	2.1	2.1	2.1	2.1	EPA, 1973
Hydrocarbons, cars	F_6	gm/km	4.1	4.1	4.1	4.1	4.1	4.1	EPA, 1973
Carbon Monoxide, trucks	F_7	gm/km	12.7	12.7	12.7	12.7	12.7	12.7	EPA, 1973
Carbon Monoxide, cars	F_8	gm/km	22.	22.	22.	22.	22.	22.	EPA, 1973
Nitrogen Oxides, trucks	F_9	gm/km	21.	21.	21.	21.	21.	21.	EPA, 1973
Nitrogen Oxides, cars	F_{10}	gm/km	3.2	3.2	3.2	3.2	3.2	3.2	EPA, 1973
Sulfur Oxides, trucks	F_{11}	gm/km	1.5	1.5	1.5	1.5	1.5	1.5	EPA, 1973
Sulfur Oxides, cars	F12	gm/km	0.081	0.081	0.081	0.081	0.081	0.081	EPA, 1973
Fugitive Dust Emission Factor,									
Topsoil	F13	kg/metric ton	0.055	0.055	0.055	0.055	0.055	0.055	Cowherd, 1974
Overburden	F_{14}	kg/metric ton	0.055	0.055	0.055	0.055	0.055	0.055	Cowherd, 1974
Coal	F_{15}	kg/metric ton	0.055	0.055	0.055	0.055	0.055	0.055	Cowherd, 1974
Process Particulate Emission Factor	F_{16}	kg/metric ton	0.025	0.025	0.025	0.025	0.025	0.025	EPA, 1973
OFF-MINE									
Fugitive Dust Emission Rate, Roads	E_1	metric tons/year	0	220	490	240	260	540	Calculated
Vehicle Exhaust Emission Rates									
Particulates, trucks	E_{17}	metric tons/year	4.3	1.0	0	0	0	0.37	Calculated
Particulates, cars	E_{18}	metric tons/year	1.0	0.12	1.2	.62	.65	0.19	Calculated
Hydrocarbons, trucks	E_{19}	metric tons/year	12.	2.8	0	0	0	1.0	Calculated
Hydrocarbons, cars	E_{20}	metric tons/year	12.	1.4	15.	7.4	7.9	2.3	Calculated
Carbon Monoxide, trucks	E_{21}	metric tons/year	74.	17.	0	0	0	6.3	Calculated
Carbon Monoxide, cars	E_{22}	metric tons/year	66.	7.8	80.	40.	42.	12.	Calculated

Potential uncontrolled emissions were calculated from the emission factors and the mass of the material that would be moved at the mine. For topsoil, overburden, and coal, the mass is calculated in the formulas, and is given by the product of the density (S), the thickness of the material in the ground (L), and the total area disturbed (T). Values for these parameters were obtained from mine plans, or were estimated. The production rate of coal (P) was used to check the consistency of the calculated mass of coal that would be removed. In the same manner, the stripping ratio (R) relates the overburden quantity to the coal produced. All topsoil was considered to be a foot (0.3 meter) in thickness.

The EPA/Cowherd estimates of emission factors required correction for local climatic conditions. Fugitive dust is generated by traffic and wind erosion, mainly on dry days; moving of material into storage areas can be dusty, even on wet, days because of exposure of subsurface dry material. It is estimated that approximately half the fugitive dust is emitted from a given area on wet or frozen days compared with dry conditions.

In order to account for rain, snow, and frozen ground, and the differing character of the materials handling processes, a climatic factor, C, was developed and applied to the uncorrected emission factor. C is the net effect of climate on fugitive dust emissions: i.e., C is the fraction of dry days times the fraction of dust generated by vehicular traffic and wind erosion, plus the sum of the fraction of dry days and half of the fraction of wet days, times the fraction of dust generated by forming and redistributing storage piles. As an example, consider the Colowyo Mine site where 65 percent of the days in a year are wet, frozen, or covered with snow, and 35 percent are dry. Then the climatic factor is:

$$\begin{aligned} C &= (0.35)(0.40 + 0.33) + \left(0.35 + \frac{0.65}{2}\right)(0.12 + 0.15) \\ &= 0.44. \end{aligned}$$

Using the local climatic descriptions, the fraction of the time that the surface is wet or frozen was estimated. It is expected that many material surfaces will be moistened with water to limit dust generation. Although the efficiency of water application as a control measure is difficult to assess because of varying soil conditions, a value of 50 percent of the uncontrolled emissions (corrected by climate) is used here (PEDCo, 1973). This is applied only to the emissions from traffic during dry days; watering would be expected to reduce uncontrolled emissions by about ten percent.

Uncertainties (two standard deviations) of fugitive dust emission estimates are on the order of a factor of two, as described in Cowherd (1974), and based on considerations of the variations in material characteristics.

Fugitive dust - off-mine roads

Unpaved roads potentially are a large source of fugitive dust from vehicular traffic. Roads within the mine site have been included in the mining fugitive dust calculations. Away from the mine property, vehicles traveling on unpaved roads, because of the mine, must be considered. An equation is included in Table VI-14 to calculate fugitive dust emissions from roads. It includes a sum of two terms, representing total potential miles traveled/year by coal haulage trucks, and total potential miles of cars of employees, times the climatic factor (C), the emission factor for roads (F_1), and a correction factor (M), for the fraction of the total roads traveled that are unpaved.

Fugitive dust emissions from unpaved roads were studied by PEDCo (1973) in an arid climate. The average emission factor obtained was about one kilogram of suspended particulate/vehicle-kilometer.

Total truck mileage for the haulage of coal was calculated from the tons of coal produced (P), the capacity of the trucks (A_1), and the distance of a round trip (D_1). One round trip to the nearest town on paved road was assumed for each of the employees at the mine (total number (N), over a distance (D_2), for the number of working days/year (U). Because of the assumptions necessary, and the limited studies performed on unpaved roads, an uncertainty of at least a factor of two must be considered for road fugitive dust emissions.

In the PEDCo report text, watering of the roads has been considered to be a control measure, with an efficiency of about 50 percent. This efficiency differs from that assumed for mine control, because experience has indicated that hard-packed established roads are better controlled by watering than new mine trades and storage piles.

Process emissions

Process emissions of suspended particulates involve two types. Half of the emissions are assumed to result as fugitive dust, and half as particulates that are 99 percent collected in control devices. The "controlled" emissions are thus one percent of one-half the "uncontrolled". This distinction is made to indicate the difference between generation of dust and emission of suspended particulate.

Fugitive dust is generated by material transport, spilling, transfers between conveyors, and mechanical operations of crushing and sorting. Process emissions also include fine particulate matter emitted directly to the atmosphere from control device exhausts. Dust that is captured by a collection system, such as a hood over a crusher, can be retained by a control device (e.g., a baghouse), with efficiencies of 99 percent or better. The uncaptured portions from conveyors, transfer points, and spillage are emitted directly to the atmosphere. As a means of estimating potential total generation of particulates, essentially all as coal dust, an emission factor of 0.44 kilograms of dust/metric ton of coal has been applied. This was obtained by interpolating between EPA emission factors given for several different crushing operations (1973). The equation for process particulate emissions is simply the coal production rate times the emission factor.

Vehicle exhaust

Suspended particulates, and four gaseous pollutants: carbon monoxide, nitrogen oxides, hydrocarbons, and sulfur oxides, are emitted from vehicles. Emission factors for internal combustion engines, both diesel and gasoline, have been obtained from EPA (1973). At the mine, there would be vehicle exhaust emissions from heavy diesel mine equipment, haulage trucks, and gasoline-powered cars and trucks. Emissions of each pollutant from haulage trucks (E_3 to E_{11}, odd subscripts) were calculated by multiplying the total yearly truck miles that would be used moving coal to the mine processing facilities, by the appropriate emission factor. Truck miles are equal to the amount of coal hauled/year (P), times the haulage round-trip distance within mine (D_3), divided by the capacity of the trucks (A_2).

Potential automobile emissions (E_4 to E_{12}, even subscripts) were based on two trips/day over a course through the mine for U days a year. The distance traveled (D_4) was doubled to account for two round-trips.

In addition to vehicle travel within the mine, coal haulage and automobile travel off-mine were considered. Calculations are similar to those described above for fugitive dust from off-mine roads.

Vehicle exhaust emission factors are based on a much wider history of measurements than fugitive dust emission factors, thus have lower uncertainties. However, due to the approximations in the traffic patterns, an uncertainty factor of two is again realistic.

Modeling Techniques

The Environmental Research & Technology Air Quality (ERTAQ) Model was used to develop the expected impacts of the regulated pollutants from site specific mines. Several model options were used in developing 24-hour and annual pollutant concentrations. A general description of ERTAQ is provided before discussing its specific use and input requirements as it was applied in this study.

Area Source Model description

The ERTAQ model is a regional model which allows the examination of multiple sources as well as multiple meteorological conditions. The model can average concentrations due to many sources over longer time periods, e.g., a season, or a year. It does not take into account such effects as changes in terrain on effluent dispersion, and it is able to calculate pollutant concentrations at only 100 pre-selected receptor sites.

The fundamental equation used in ERTAQ is the Gaussian plume equation which estimates ground-level pollutant concentrations by the methodology presented in the Workbook of Atmospheric Diffusion Estimates (Turner, 1972). The general form of the equation for the coordinate system presented in Appendix D is:

$$\chi(0,0,z) = \frac{q(x,-y,H)}{2\pi\sigma_y\sigma_z u} \exp\left[-1/2\left(\frac{y}{\sigma_y}\right)^2\right] \cdot \left\{\exp\left[-1/2\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-1/2\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\} \cdot \left[e^{-t/\lambda}\right] \qquad \text{EQUATION 1}$$

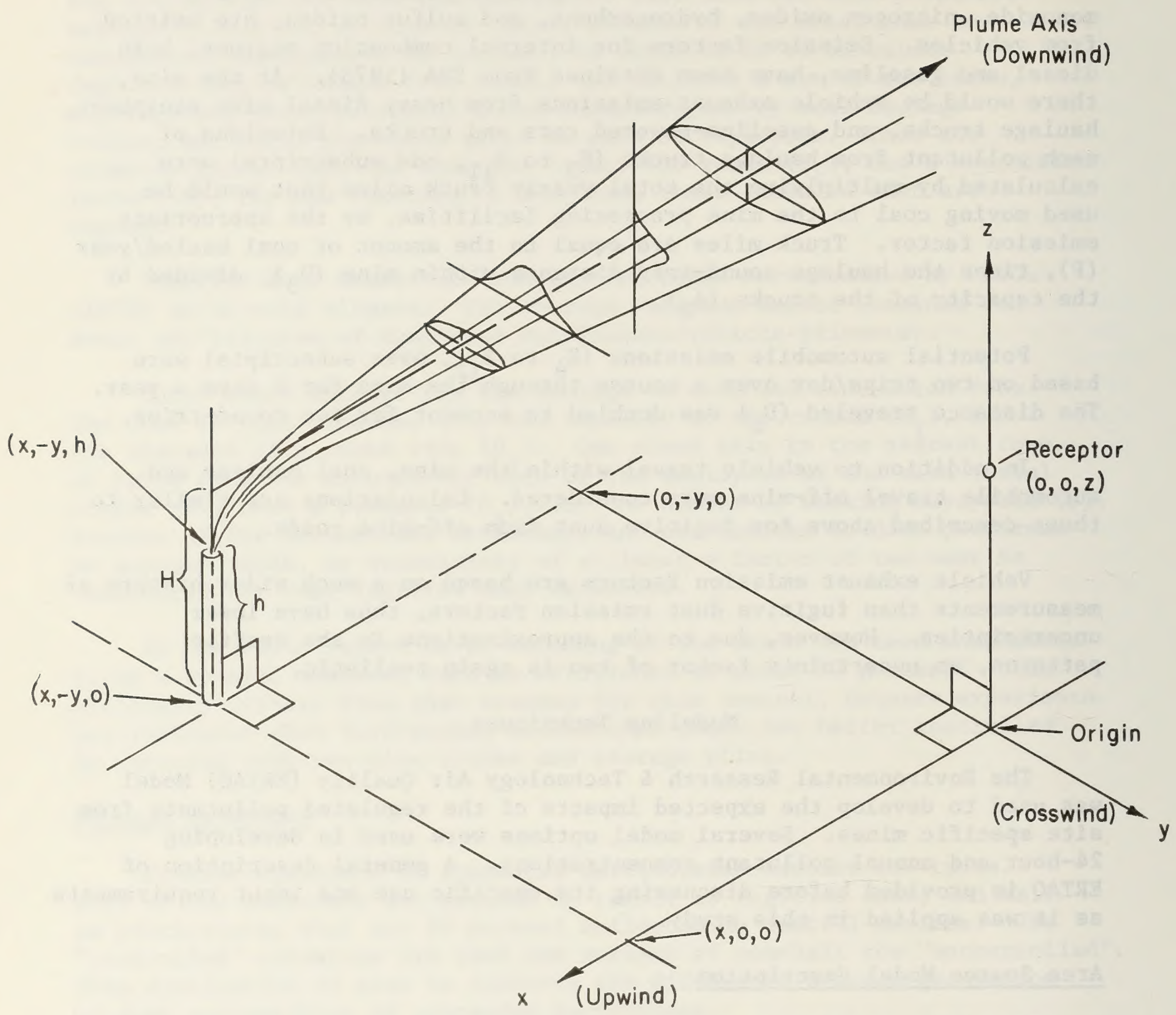


FIGURE VI-3

Coordinate system showing Gaussian distributions in the crosswind and vertical directions.

where

(x,y,z)	are the (upwind, cross-wind, and vertical) components of a Cartesian coordinate system, such that the receptor point is located at or vertically above the origin (expressed in units of length) and the source at the point $(x,-y,H)$,
$\chi(0,0,z)$	is the ground-level pollutant concentration from an elevated point source at a receptor $(0,0,z)$ (mass/length^3),
H	is the effective height (stack height plus plume rise) of emission and, therefore, the centerline height of the plume (length),
q	is the source strength (mass/time),
	are the dispersion coefficients that are measures of cross-wind and vertical plume spread. These two parameters are functions of downwind distance and atmospheric stability (length),
u	is average wind speed (length/time),
λ	is a decay rate for pollutant in the atmosphere (time),
and t	is the travel time from source to receptor and equals x/u (time).

Calculations performed with the ERTAQ model involve multiple applications and spatially-integrated forms of the Gaussian plume equation. The resulting concentrations are those expected during five stability categories. These categories are those specified by Turner, except that ERTAQ Stability 5 is a condensation of Turner Stabilities E and F (Table VI-16).

ERTAQ considers six wind speed categories, represented by the following speeds: .72, 2.57, 4.38, 6.95, 9.78, and 13.1 mps, which are identical for each stability class. The combination of five stability classes, six wind speed classes, and sixteen wind directions give a total of 480 weather conditions considered in the ERTAQ model.

The calculation of short-term concentrations -- sector averaging

Hourly ground-level concentration estimates can be obtained directly from Equation 1 by setting $z = 0$. However, since the contribution of both area and point sources are calculated, a modified version of the equation is used.

Although the probability of all wind directions is continuous function over long time periods, for model computation purposes discrete wind directions are specified with respect to a 16-point compass, corresponding to 22.5¼ angular sectors. Over long periods it is often assumed that all wind directions within a given 22.5¼ sector occur with equal frequency; thus the effluent could be assumed to be uniformly distributed in the horizontal within the sector. However, this assumption would result in discontinuities in calculated concentrations at sector boundaries, when considering several sources. A more reasonable distribution is obtained by using a linear interpolation between sector centerlines. In this case, the concentration at a given receptor location is composed of proportional contributions from both the sector containing the receptor and from the nearest adjacent sector. The linear interpolation term is given by:

$$\frac{K(c - |y|)}{c}$$

TABLE VI-16

A General Key to the Turner Stability Classification System

Surface	Day			Night	
Wind	Incoming Solar Radiation			Thin Overcast or[2]	> 4/8
m/sec	Strong	Moderate	Slight	≤ 3/8 Cloud Cover	Cloud Cover
<2	A[1]	A-B	B	-	-
2-3	A-B	B	C	F	E
3-5	B	B-C	C	E	D
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

[1] A Extremely Unstable
B Moderately Unstable
C Slightly Unstable
D Neutral
E Stable
F Extremely Stable

[2] Neutral Conditions Assumed for all Overcast Conditions

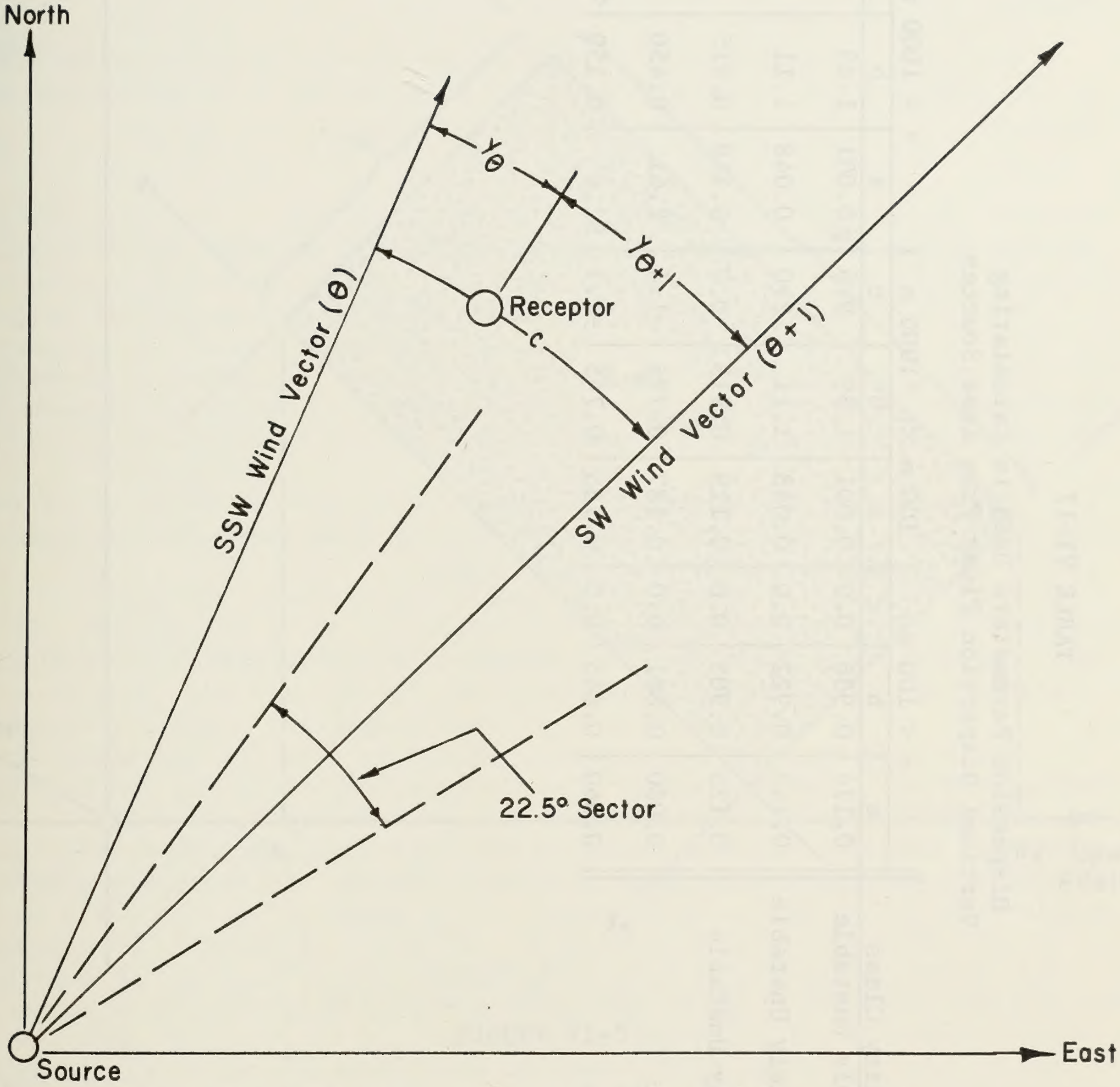


FIGURE VI-4

Geometry of the linear interpolation between adjacent wind direction sectors.

TABLE VI-17

Dispersion Parameters Used in Calculating Vertical Dispersion Plume From Area Sources

Stability Class	$x < 100$ m			100 m $<x<$1000 m			$x < 1000$ m		
	a	b	c	a	b	c	a	b	c
1 Extremely Unstable	0.174	0.936	0.0	0.001	1.89	9.6	0.001	1.89	9.6
2 Moderately Unstable	0.143	0.922	0.0	0.048	1.11	2.0	0.048	1.11	2.0
3 Slightly Unstable	0.123	0.905	0.0	0.119	0.915	0.0	0.119	0.915	0.0
4 Neutral	0.080	0.881	0.0	0.187	0.775	-1.4	2.61	0.450	-25.5
5 Stable	0.060	0.845	0.0	0.135	0.745	-1.1	52.6	0.150	-126.0

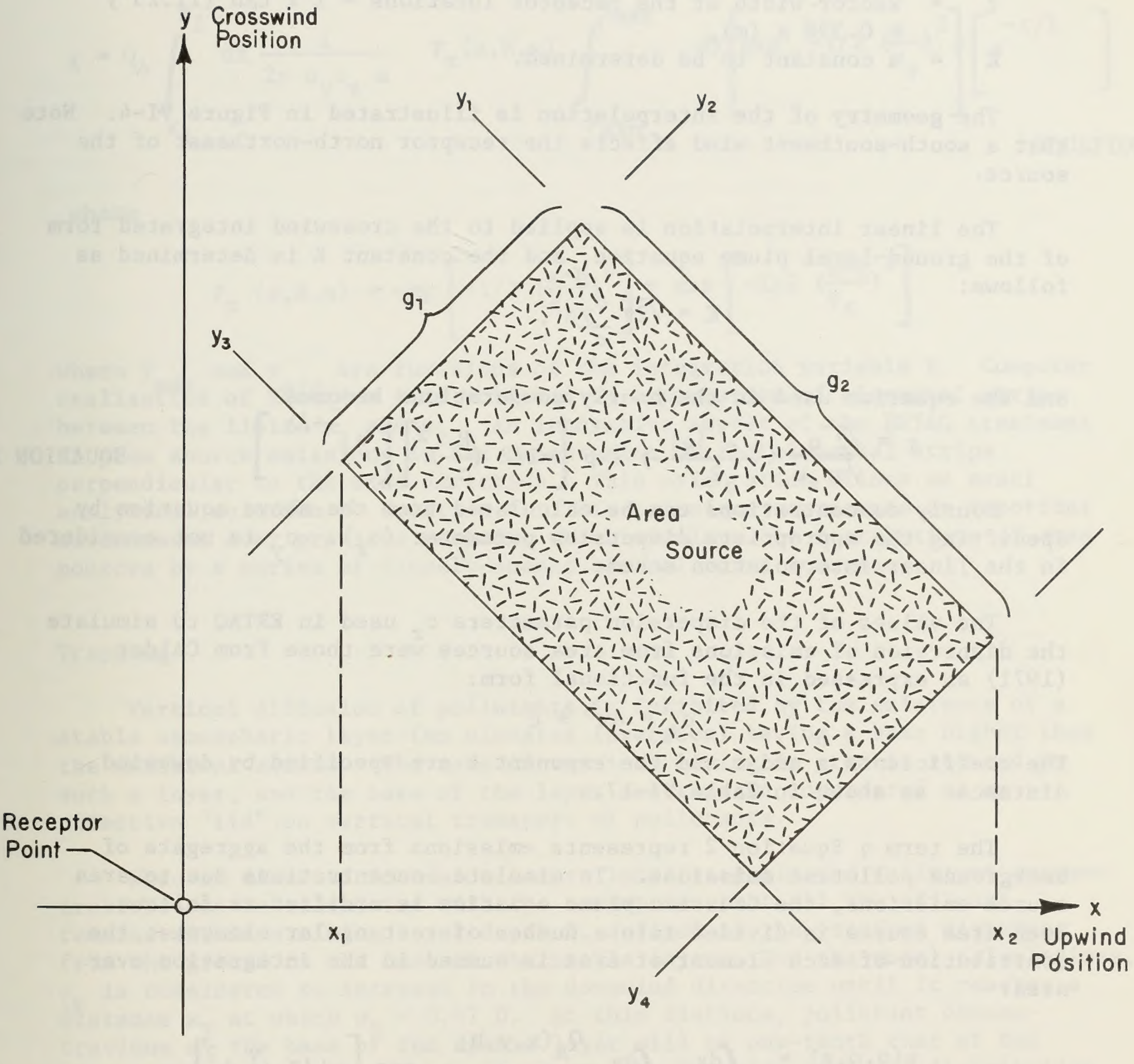


FIGURE VI-5

Geometry for area source with dimensions g_1 and g_2 in the horizontal plane; shown in the receptor-centered, wind oriented, coordinate system.

where

y = cross-wind distance between the receptor and the sector centerline (m),

c = sector width at the receptor locations = 2 x tan (11.25°) = 0.398 x (m),

K = a constant to be determined.

The geometry of the interpolation is illustrated in Figure VI-4. Note that a south-southwest wind affects the receptor north-northeast of the source.

The linear interpolation is applied to the crosswind integrated form of the ground-level plume equation, and the constant K is determined as follows:

$$K = \sqrt{2\pi}\,\frac{\sigma_y}{c}\ ,$$

and the equation used in the hourly computations becomes

$$\chi = \frac{\sqrt{2}\,q}{\sqrt{\pi}\sigma_z u}\left(\frac{c - |y|}{c^2}\right) \exp\left[-1/2\left(\frac{H}{\sigma_z}\right)^2\right]\left[e^{\bar{-}+/\lambda}\right] \qquad \text{EQUATION 2}$$

Hourly concentrations can be calculated from the above equation by specifying the appropriate dispersion parameter (σ_z). σ_y is not considered in the linear interpolation scheme.

The values of the dispersion parameters σ_z used in ERTAQ to simulate the dispersion of emissions from area sources were those from Calder (1971) as expressed in the functional form:

$$\sigma_z = ax^b + c$$

The coefficients a and c and the exponent b are specified by downwind distance. as shown in Table VI-17.

The term q Equation 2 represents emissions from the aggregate of background pollutant emissions. To simulate concentrations due to area source emissions, the Gaussian plume equation is modified as follows. Each area source is divided into a number of rectangular elements; the contribution of each element of area is summed in the integration over area:

$$\chi(o,o,z) = \int_x dx \int_y dy\, \frac{Q_A(x,y,H)}{2\pi\ \sigma_y\sigma_z\ \ u}\ \exp\left[-1/2\left(\frac{Y}{\sigma_y}\right)^2\right] \qquad \text{EQUATION 3}$$

$$\cdot\left[\exp\ \ -1/2\left(\frac{z-H}{z}\right)^2 + \exp\left[-1/2\left(\frac{z+H}{z}\right)^2\right]\right]\left[e^{-t/\lambda}\right]$$

A rectangular area source was assumed with a uniform distribution Q_A. The geometry applicable to this discussion is given in Figure VI-5. Equation B-4 becomes

$$\chi = Q_A \int_{x_1}^{x_2} dx \frac{1}{2\pi \sigma_y \sigma_z u} F_z(a,H,x) \int_{y_{min}}^{y_{max}} dy \left[\exp -1/2 \left(\frac{y}{\sigma_y}\right)^2 \right] \left[e^{-t/\lambda} \right]$$

EQUATION 4

where

$$F_z(a,H,x) = \exp \left[-1/2 \left(\frac{z-H}{\sigma_z}\right)^2 \right] + \exp \left[-1/2 \left(\frac{z+H}{\sigma_z}\right)^2 \right]$$

where y_{max} and y_{min} are functions of the integration variable X. Computer realization of Equation 4 is achieved by a summation of elemental strips between the limits x_1 and x_2. An innovative aspect of the ERTAQ treatment of area source emissions is the orientation of the elemental strips perpendicular to the wind direction. This orientation allows an exact analytical solution to Equation 4. This technique represents an important advancement over previous methods, which simulate the contrbutions of area sources by a series of closely-spaced virtual point sources.

Trapping

Vertical diffusion of pollutants is inhibited by the existence of a stable atmospheric layer (an elevated inversion) having a base higher than the emissions source. The rate of vertical mixing is greatly reduced in such a layer, and the base of the layer can thus be considered as an effective "lid" on vertical transport of pollutants.

When an elevated inversion occurs locally, estimated pollutant concentrations can be calculated with the assumption that all the effluent remains within a mixing layer depth D, defined as the vertical distance from the ground to the base of the stable layer. For the model calculations, σ_z is considered to increase in the downwind direction until it reaches a distance x_T at which $\sigma_z = 0.47$ D. At this distance, pollutant concentrations at the base of the stable layer will be one-tenth that at the plume centerline. Up to this distance, the Gaussian vertical distribution is assumed. At distance x_T, the trapping effect of the elevated stable layer begins to be effective, and uniform mixing below the base of the stable layer is assumed to occur at downwind distance $2x_T$. For distances $x \geq 2x_T$, the average concentration due to a point is calculated with the assumption of full mixing layer:

$$\chi = \frac{Q(c-y)}{Duc^2}$$

EQUATION 5

For distances between x_T and $2x_T$, X is determined by a linear interpolation between Equation 2, evaluated at X_T and Equation 5, evaluated at $2x_T$. A similar expression is used for the area sources.

Calculation of annual averages

For each receptor, an estimate of X due to each source is obtained by calculating the concentration for each wind speed class, wind direction, and stability class. The annual average concentrations due to all sources, $\overline{X}$, is then obtained by summing all concentrations and weighing each one according to its frequency for the particular wind direction, wind speed class, and stability class. The average concentration is:

$$\overline{\chi} = \sum_{K}\sum_{L}\sum_{J} F(J,K,L) \quad \chi(J,K,L) \qquad \text{EQUATION 6}$$

where

F(J,K,L) = normalized frequency during the period of interest for wind direction interval K, wind speed class J, and stability class L,

x(J,K,L) = average ground-level concentration calculated from Equations B-2 and B-4 as appropriate.

The total average annual concentration at a specific receptor due to all sources is obtained by summing the results of Equation 6 for all sources. For each of the 16 wind direction intervals, wind speed is defined in six categories and stability class in five categories, where stability class 1 is very unstable, and stability 5 is stable. Thus, a three-dimensional array of 480 categories is established. However, only a few wind directions result in non-zero contributions for specific source-receptor pairs.

Model application

Site specific analysis of a coal mine does not require some of the ERTAQ features discussed above. Each mine was considered a single area source emitting from the surface, so multiple source features were not used. In addition, the pollutants modeled: CO, TSP, NO_x, and SO_2, were assumed to be passive, so no exponential decay factor was applied.

The concept of plume rise does not pertain to a coal mine; however, an initial mixing depth over the area of ten meters was assumed. This feature allows the pollutant modeled to form "puffs" ten meters deep before dispersing downwind. Mixing depths used to simulate trapping conditions were taken from Holzworth (EPA, 1972). They are shown in Table VI-18.

Ideal use of the model requires inputting a stability wind rose. This is a joint frequency distribution of stability classes, wind directions, and wind speeds. Since no actual wind and stability data are available from the mine sites, estimates were obtained from the Craig and Hayden weather stations, and from Grand Junction.

In order to predict worst case 24-hour concentrations, a wind speed of .77 meters/second was assumed to persist for eight hours during stable conditions. No assumptions about the frequency of occurrence of these specifications were necessary in order to run the model; therefore, the numerical results are dependent only on the Gaussian plume assumptions of dispersion analysis and the emissions estimates.

TABLE VI-18

Mean Mixing Heights (meters) in Northwestern Colorado (Holzworth 1972)

Season	Morning	Afternoon
Winter	329	1,160
Spring	628	3,166
Summer	307	3,940
Fall	273	2,133
Annual	384	2,600

In order to estimate the frequency of occurrence of the worst-case 24-hour conceentrations predicted, it was necessary to examine meteorological data from Craig and Hayden measured for the Yampa project, and from the National Weather Service data from Grand Junction.

Upper-level temperature soundings used to determine atmospheric stability were taken near Craig and Hayden during the following months: November, 1970; March, May, September and November, 1971; February, June, and November, 1972; and January, 1973. The frequency of occurrence of four stability classes determined from the soundings is shown in Table VI-19. The transitional class is not a standard Turner classification but is defined to represent all times when stable conditions are changing to unstable conditions. Transition periods occur most frequently during the late morning hours, when increased solar heating dissipates a stable layer which develops during the night. The transition class is similar to Turner's stability class C.

Craig and Hayden soundings were conducted most frequently during the winter months, so the frequency distribution of stability classes is not representative of an entire year. Stability data from the National Weather Service Station in Grand Junction representing the winter months are shown in Table VI-20 for comparison. They agree remarkably well with the Craig and Hayden data; therefore, the annual frequency of occurrence of each stability class observed in Grand Junction was assumed to be representative of the study area.

Next it was necessary to determine what percent each stability class occurred during down-valley flow. This distribution was provided by the Yampa Project study, which shows that down-valley flow at Hayden occurs about 20 percent of the time with the following stability breakdown: 11 percent stable conditions, four percent neutral conditions, five percent transition conditions, and zero percent unstable conditions. Finally it was observed that wind speeds during stable conditions were less than one mps 50 percent of the time.

TABLE VI-19

Frequency of Stability Classes at Several Locations in Northwestern Colorado

Location	Period of Record	Unstable (A,B)[1]	Transition (C)[1]	Neutral (D)[1]	Stable (E,F)[1]
Hayden	Nov 70 - Jan 73[2]	2.6%	15.1%	31.8%	50.5%
Craig	Nov 70 - Jan 73[2]	4.1%	15.1%	29.5%	48.3%
Grand Junction	Winter	8.4%	12.3%	30.0%	49.3%
Grand Junction	Annual	13.2%	13.9%	32.8%	40.1%
Study Region Estimate	Annual	10.1%	14.6%	28.3%	46.2%

[1] Turner stability class notation

[2] Data sampling was not continuous over this period but occurred more often in winter

TABLE VI-20

Frequency of Wind Speed Classes Within Each Stability Class for Down-Valley Flow

	Wind Speed Meters Per Second						
Stability	.72	2.57	4.38	6.95	9.78	13.1	Total
Unstable (A+B)[1/]	0	0	0	0	0	0	0
Transition (C)	.9	2.6	1.4	.2	.1	0	5.2
Neutral (D)	.1	.4	1.1	1.5	.9	0	4.0
Stable (E+F)	4.2	4.9	1.5	.2	0	0	10.8

[1/] Turner stability class notation

Applying these estimates to the 24-hour worst-case conditions to develop an estimate of the frequency of occurrence of the predicted concentrations is straightforward. Down-valley flow with stable conditions occurs 12 percent of the time; 50 percent of this, or six percent of the time, down-valley flow will occur during stable condttions at wind speeds less than one mps. Therefore, the worst case predicted 24-hour concentrations will occur a maximum of 22 days/year. Because of rough approximations used in developing this estimate, and uncertainties in the emissions estimates, the actual number of days is assumed to be between 10-30 days.

Using ERTAQ to estimate annual average concentrations is more difficult, because the frequencies of stability classes, wind speeds, and wind directions are used in the model itself. Therefore, the model results are dependent not only on the accuracy of emissions estimates and the Gaussian plume assumptions, but on the reliability of the stability wind rose frequency distribution. One of these variables, the wind direction frequency distribution, was eliminated by considering only one direction, down-valley. Because the down-valley direction is known to be the most frequent, occurring about 20 percent of the time, annual concentrations will be highest in that direction. The frequency of each stability class in the down-valley direction was discussed above. The distribution of wind speeds in each class was derived from the Yampa Project meteorological studies and is shown in Table VI-20. For lack of better data, this distribution was assumed to be representative of each mine site. The annual concentrations discussed in this text are believed to be accurate to within a factor of three.

Gaussian plume assumptions

The most important assumptions upon which equation 1 is based are the following:

1. Wind speed and direction in the vicinity of the point source are constant throughout the period of interest; wind speed is specified as an increasing function of height;

2. When the effluent enters the atmosphere, the plume rises until it reaches an equilibrium altitude; the plume center line height remains constant at all downwind distances;

3. At any downwind distance, the maximum concentrations occurs at the plume centerline; the distribution of concentration values off the centerline is given by the product of two Gaussian or bell-shaped curves;

4. Concentration profiles described by the Gaussian form are not "instantaneous" plume profiles; instead they represent concentrations averaged over one hour;

5. None of the effluent is lost from the plume; therefore when the plume intersects the ground surface, it is assumed that all material is reflected back above the ground;

6. Effluent rate is constant, and the meteorological parameters determining plume geometry are constant; (i.e., the equation represents steady-state conditions).

Rough terrain

Terrain features were not considered explicitly in the model calculations, because the meteorological date base was insufficient to execute a complex terrain analysis. However, terrain was included implicitly in two ways:

1. Up-valley-down-valley flow characteristics were included in the meteorological specifications; rough terrain features were therefore included insofar as they affected wind directions and stability classes corresponding to those directions;

2. Routh terrain was included by establishing an initial mixing depth of ten meters before dispersing pollutants; therefore, additional mechanical mixing generated by the terrain is implicitly accounted for.

Meteorological specifications

The mixing depth of the atmosphere was specified to simulate trapping conditions. Average climatological mixing depths for northwestern Colorado were used (Holzworth, 1972). They are shown in Table VI-18.

ERTAQ requires a stability wind rose to generate long-term concentrations. A stability wind rose is a joint frequency distribution of stability classes, wind directions, and wind speeds. Surface wind observations and upper air soundings taken for two years at the Hayden Weather Station for the Yampa Project were used to extract a stability wind rose. The stability classes considered were: unstable, transitional (slightly unstable), neutral, and stable. The wind rose for each class is shown in Figures VI-6 through VI-9.

Point Source Model description

The Point Source Diffusion Model (PSDM) was used to evaluate the impact of power plant emissions. This model solves Equation 1 using dispersion coefficients specified by the American Society of Mechanical Engineers (ASME) for elevated point sources. Terrain is included in the modeling by permitting the plume to be lifted one-half of the difference between the height of the receptor (the point on the ground for which the concentration is being computed), and the height of the stack base, with the additional restriction that the plume shall always be at least half the height above the ground that it would be, were there no topography (Figure VI-10).

Because the emissions from the power plant stacks are much hotter than the surrounding air, they are expected to rise until thermal equilibrium is reached. PSDM accounts for plume rise, using the most recent Briggs plume rise equations (Briggs, 1970) in forms that depend on atmospheric stability. The simultaneous consideration of both the plume rise as a function of downwind distance, and of the topography surrounding the point source, provides a realistic simulation of the downwind transport of effluent released in areas characterized by irregular terrain.

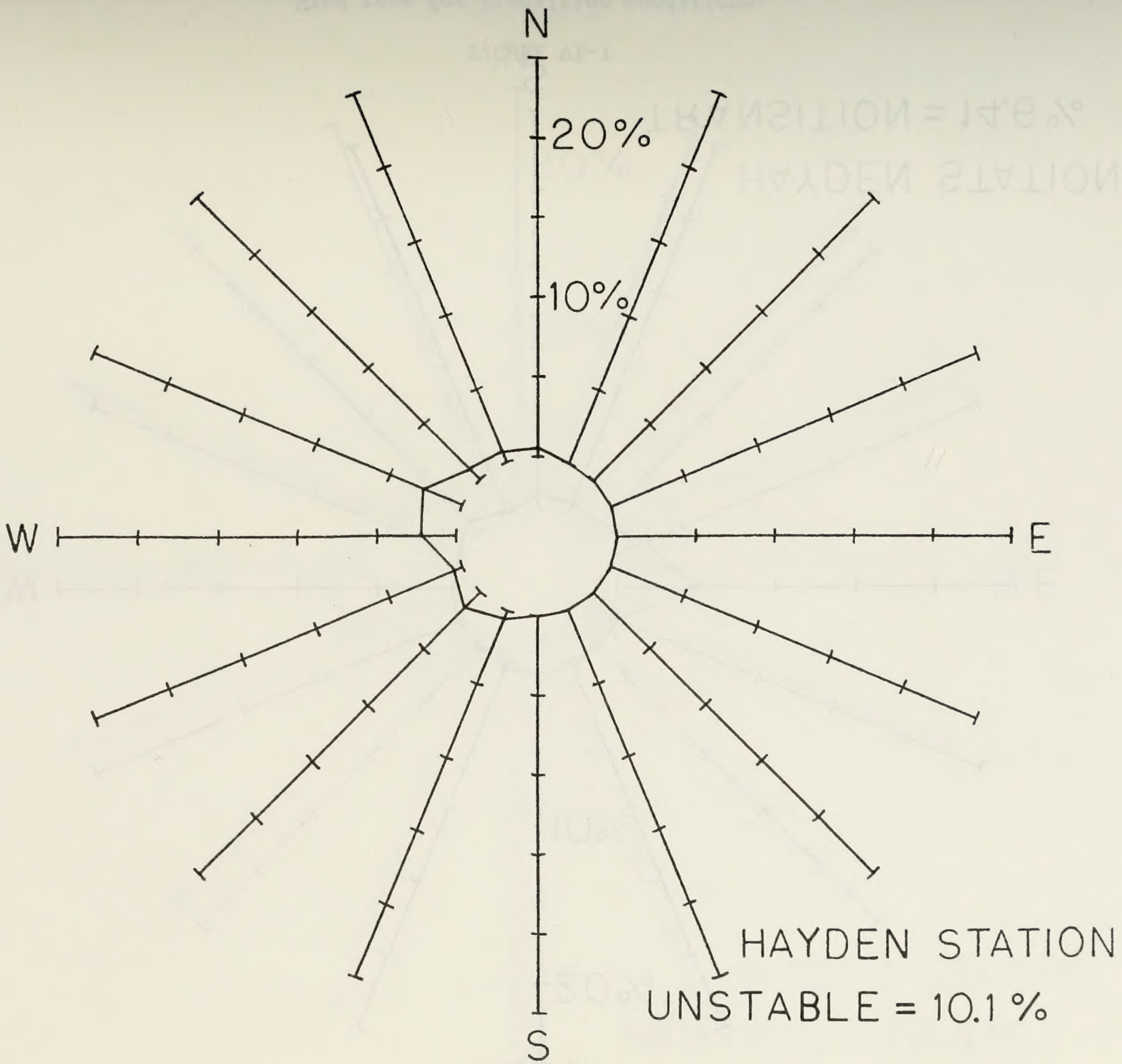


FIGURE VI-6

Wind rose for unstable conditions.

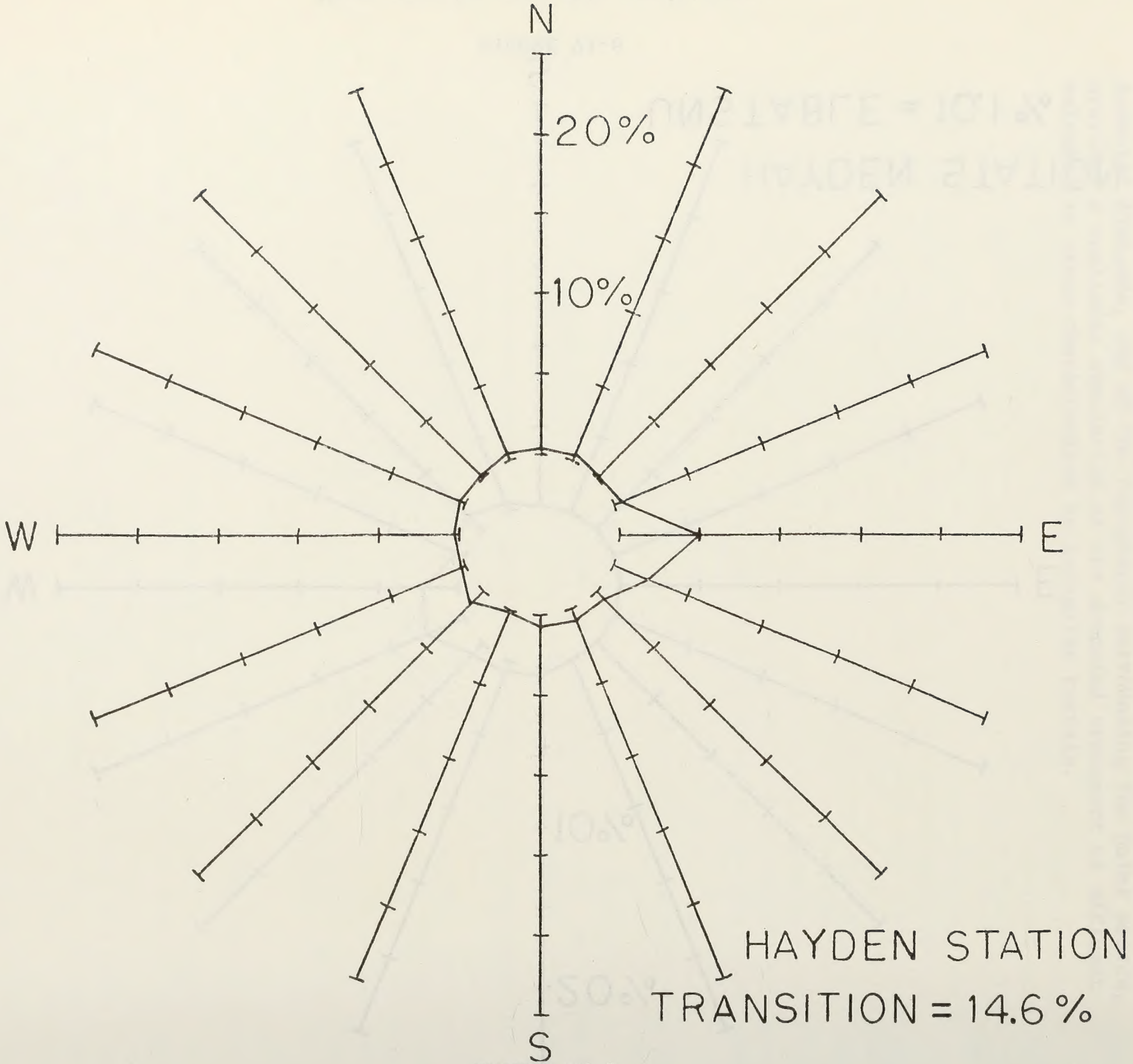


FIGURE VI-7

Wind rose for transition conditions.

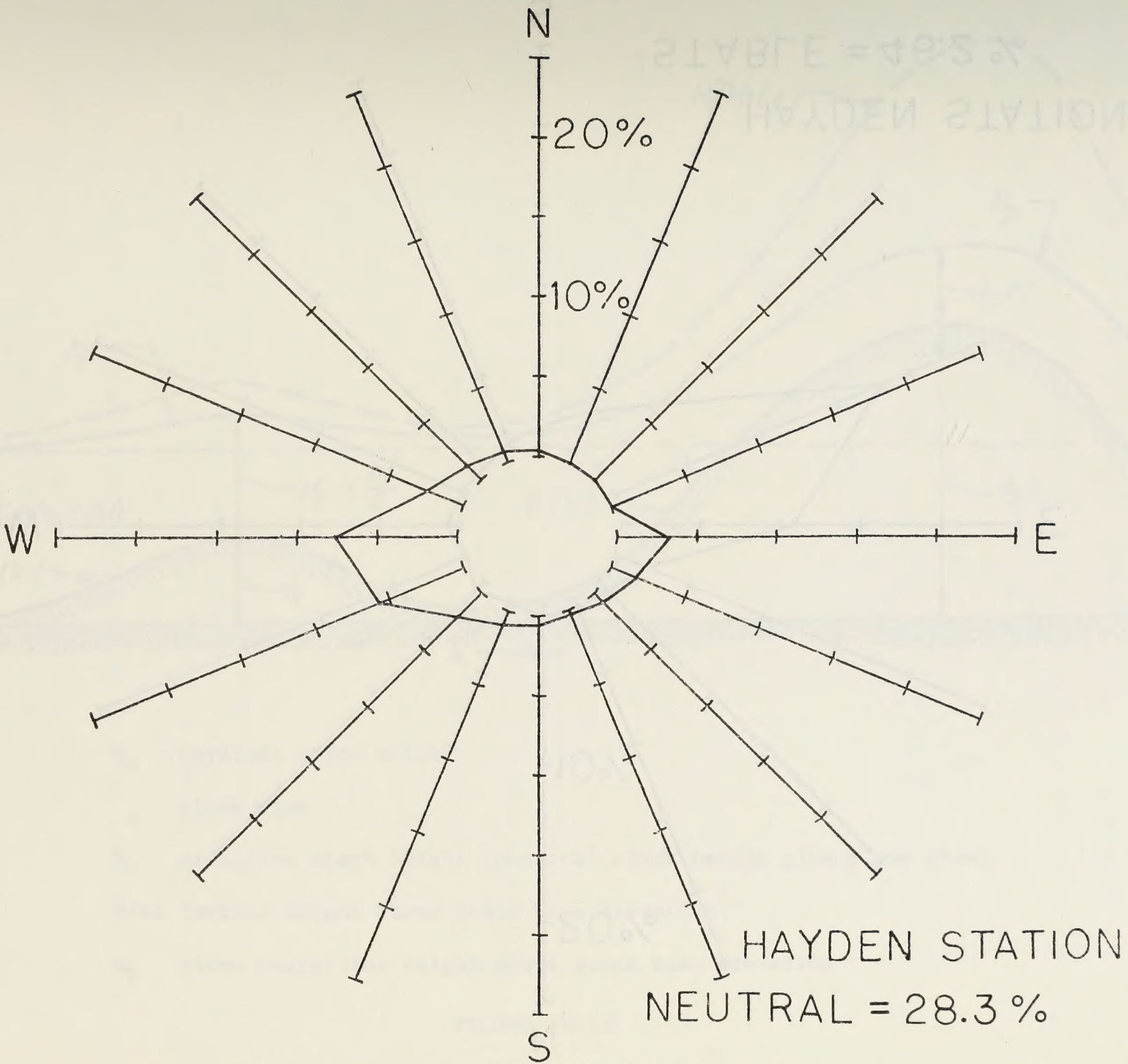


FIGURE VI-8

Wind rose for neutral conditions.

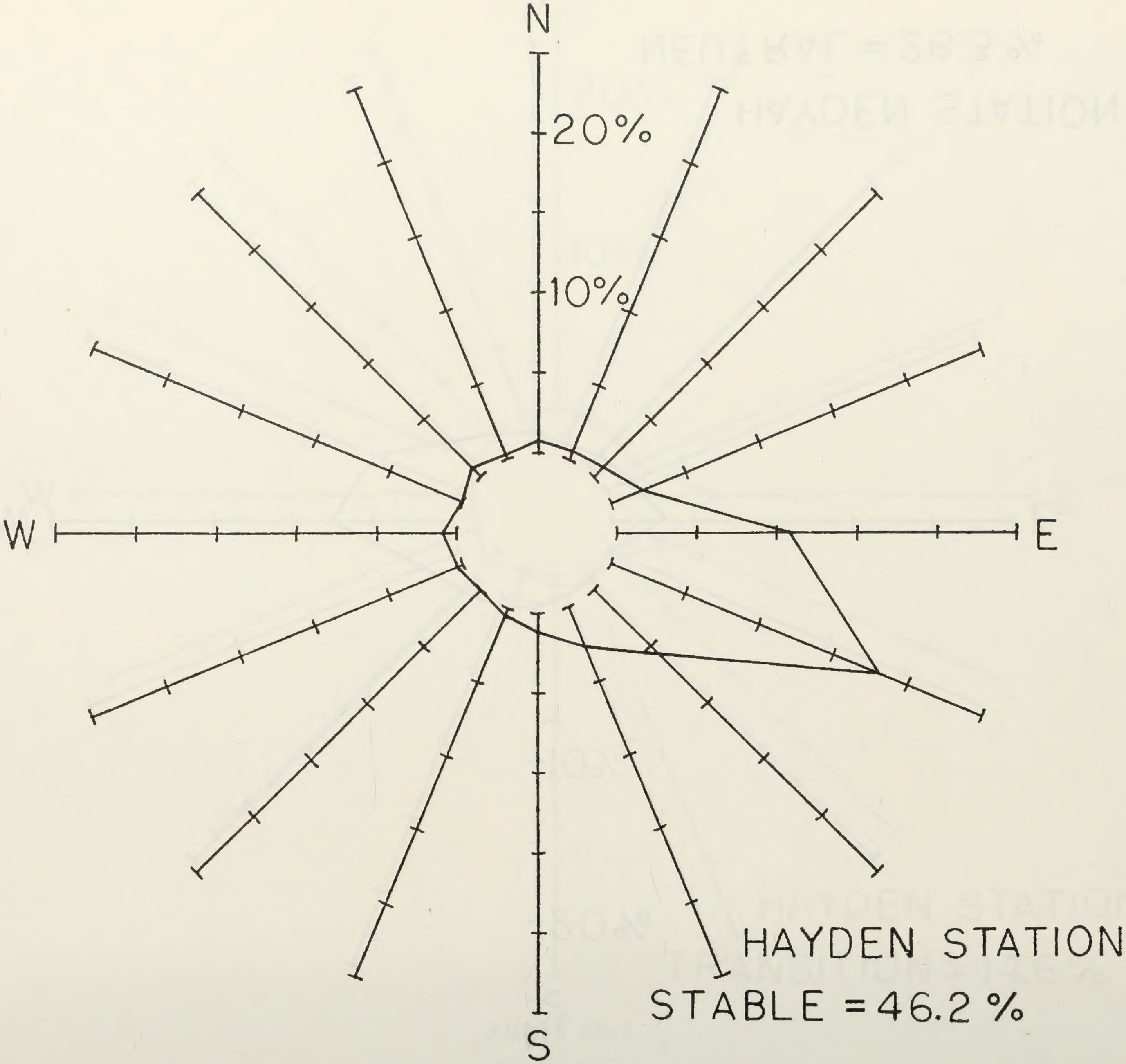
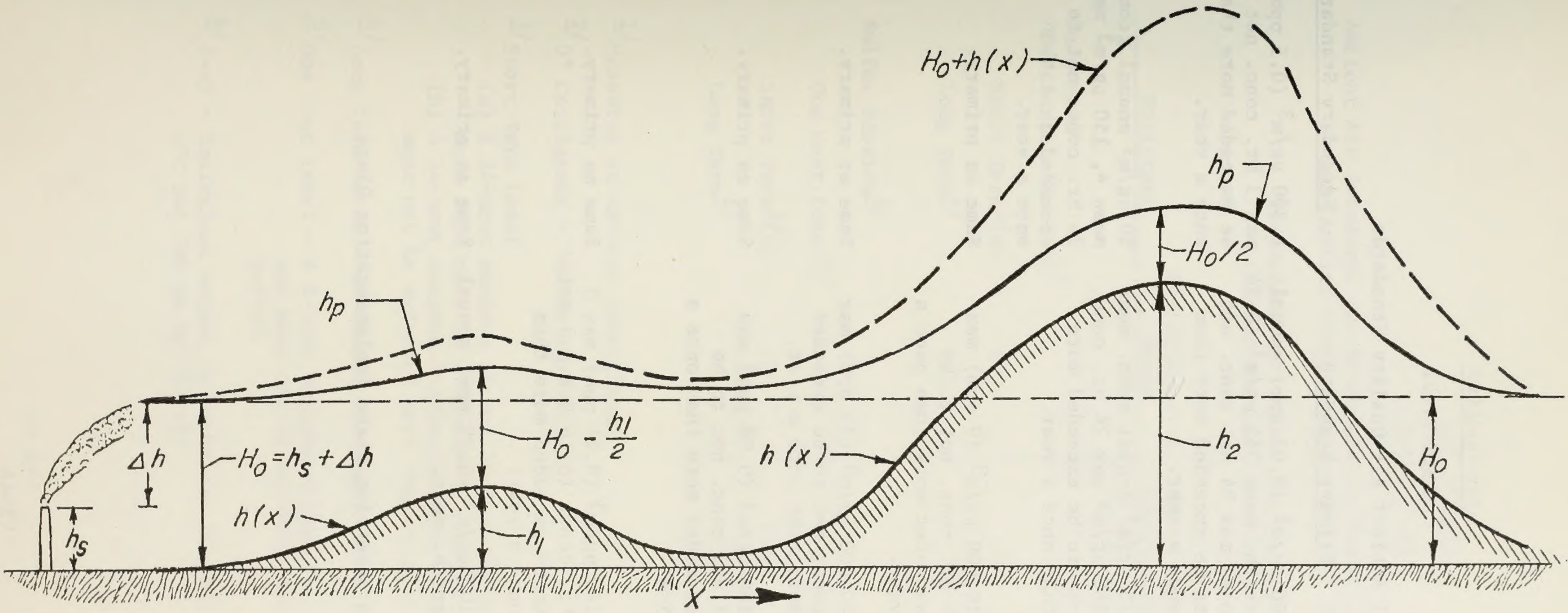


FIGURE VI-9



h_s	physical stack height
h	plume rise
H_o	effective stack height (physical stack height plus plume rise)
h(x)	terrain height above stack base elevation
h_p	plume centerline height above stack base elevation

FIGURE VI-10

Treatment of terrain influence upon plume height used in model PSDM.

TABLE VI-21

National Ambient Air Quality Standards

	Pollutant	Primary Standard	Secondary Standard
1.	Sulfur Oxides	80 μg/m^3 (0.03 ppm) annual arith. mean 365 μg/m^3 (0.14 ppm) max 24 hr. conc. not to be exceeded more than once a year.	1,300 μg/m^3 (0.5 ppm) max 3 hr. conc. not to be exceeded more than once a year.
2.	Particulate Matter	75 μg/m^3 annual geom. mean 260 μg/m^3 max 24 hr. conc. not to be exceeded more than once a year.	60 μg/m^3 annual geom. mean *, 150 μg/m^3 max 24 hr. conc. not to be exceeded more than once a year.
3.	Carbon Monoxide	10,000 μg/m^3 (9 ppm) max 8 hr. conc. not to be exceeded more than once a year.	Same as primary.
		40,000 μg/m^3 (35 ppm) max conc. not to be exceeded more than once a year.	Same as primary.
4.	Photo Chemical Oxidants (corrected for NO_2 and SO_2 interference)	160 μg/m^3 (0.08 ppm) max 1 hr. conc. not to be exceeded more than once a year.	Same as primary.
5.	Hydrocarbons (corrected for CH_4)	160 μg/m^3 (0.24 ppm) max 3 hr. conc. (6 to 9 a.m.) not to be exceeded more than once a year.	Same as primary.
6.	Nitrogen Oxides (as Nitrogen Dioxide)	100 μg/m^3 (0.05 ppm) annual arith. mean.	Same as primary.

* To be used as guide in assessing State Implementation Plans.

TABLE VI-22

Ambient Air Standards for Metropolitan Denver Air Quality Control Region, Air Quality Control Areas, and the State of Colorado

Suspended Particulate Matter and Sulfur Dioxide
(Micrograms per cubic meter - $\mu g/m^3$)

Pollutant	Non-Designated Areas	Metro-Denver Air Quality Control Region, and Designated State Areas		
		1973	1976	1980
Suspended Particulate Matter[1]				
Short Term[3](a)	150	200	180	150
Long Term[4]	45	70	55	45
Sulfur Dioxide[2]				
One Hour Level[5]		800 (0.28)[6]	300 (0.10)[6]	
Short Term[3](b)	15 (0.0050)[6]	300 (0.10)[6]	150 (0.050)[6]	55 (0.020)[6]
Long Term[4]		60 (0.020)[6]	25 (0.0090)[6]	10 (0.0040)[6]

[1] Measured at ambient conditions.

[2] 0° Centigrade - 760 mm Hg (Torr.)

[3] Short Term Level
- (a) A 24-hour maximum of any 24-hour period and must not be exceeded more than once in a 12-month period.
- (b) A 24-hour maximum arithmetic mean of any 24-hour period, and must not be exceeded more than once in a 12-month period.

[4] Long Term Level - An annual arithmetic mean of all 24-hour concentrations.

[5] One Hour Level - A 1-hour maximum arithmetic mean in any 24-hour period, and must not be exceeded more than once in any 1-month period.

[6] (--) = Equivalent values in parts per million (1 ppm = 2860 $\mu g/m^3$ at 0°C and 760 mm Hg (Torr)).

TABLE VI-23

Allowable Incremental Increases for Class I and Class II Areas

($\mu g/m^3$)

Pollutant	Class I	Class II
Particulate Matter		
Annual Geometric Mean	5	10
24 Hour Maximum	10	30
Sulfur Dioxide		
Annual Arithmetic Mean	2	15
24 Hour Maximum	5	100
3 Hour Maximum	25	700

Soils

APPENDIX D

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Soil Associations of the Study Region

The general soil map (Map 8, Appendix B) shows the soil associations in Moffat, Routt, and part of Rio Blanco Counties, Colorado. A soil association is a landscape that has a distinctive proportional pattern of soils classified by the name of the major soils. The soil associations in this inventory have been grouped into five kinds of soil orders for broad interpretive purposes. Each of the broad groups and the soil associations in each group are described in the following pages and tables.

Alfisols

Typic Cryoboralfs, skeletal-Rock Outcrop Association, Association #1, (287,784 acres)

This association consists of sloping to steep soils on mountain slopes and mesas (8-25+ percent slopes). Elevations range from 8,000-11,000 feet. The average annual precipitation is 24 inches+. The soil moisture regime is ustic; average annual soil temperature is less than 47°F; average summer soil temperature is more than 59°F, (cryic), and the frost-free season is 30-45 days.

This association is about 70 percent Typic Cryoboralfs, skeletal, 20 percent rock Outcrop, and 10 percent unidentified minor soils, scattered on southerly slopes. These soils and land type are located in the eastern part of the study area with small areas in the extreme northwestern part.

Typic Cryoboralfs, skeletal soils are moderately-deep to deep, well-drained soils over residuum, formed in residuum and colluvium from shale and granitic rocks.

Typically they have an accumulation of organic matter, O horizon, overlying a light-colored, gravelly (more than 15 percent course fragments) loamy or silty material about 10 inches thick. The subsoil (10-40 inch layer) is a bright-colored, very gravelly (more than 35 percent coarse fragments), loamy (less than 35 percent clay) material with clay films (B2t horizon) on the ped surfaces. Base saturation is more than 35 percent. Hard bedrock is 40-60 inches.

Typic Cryoboralfs, skeletal soils are rapidly permeable; the effective rooting depth is 40-60 inches+. Available water capacity is low because of coarse fragments; surface runoff is medium and erosion hazard is low.

The principal limiting soil feature of Typic Cryoboralfs is steep slopes and the presence of stones and Rock Outcrops. The potential for frost heaving is moderate. Deep cuts along uphill side of roads can cause exposures of underlying rock. The large volume of coarse fragments in the subsoil, and the Rock Outcrops cause excavation problems, especially associated with installation of underground utilities; these soils have a poor potential for low buildings. The opportunities for topsoil are poor poor because of steep slopes, coarse fragments, and thin surface layers.

Sediment yield from this association is less than 0.1 acre-foot/square mile/year (Colorado Land Use Commission). These soils are used for woodland, wildlife, recreation, and watershed. The general vegetative type is conifer. Reclamation potential is poor because of coarse fragments and steep slopes.

Aridosols

Borollic Haplargids, loamy-Ustic Torriorthents, loamy Association, Association #9, (23,077 acres)

This association consists of nearly level to moderately steep (0-25 percent slopes) soils on foothills and fans. Elevation ranges from 6,00-8,000 feet. The average annual precipitation is about 12-15 inches; moisture regime is aridic; the average annual soil temperature is less than 47°F (frigid), and the frost-free season is 60-90 days.

The association has about 60 percent Borollic Haplargids, 20 percent Ustic Torriorthents, 15 percent Argiborolls, and 5 percent of unidentified minor soils, located in the extreme southern part of Routt County.

Borollic Haplargids are moderately deep, well-drained soils over shale and sandstone. Typically, they have a thin, dark-colored, loamy surface layer, A1 horizon, less than 7 inches thick. The subsoil, 10-36 inch layer, B2t horizons, is loamy, with thin clay films on the ped surfaces. The substratum is fractured bedrock. These soils are rapidly permeable; effective rooting depth is 20-36 inches. Available water capacity is moderate; surface runoff is rapid and erosion hazard is high.

Ustic Torriorthents are moderately deep, well-drained soils over shales and sandstone. Typically they have a light-colored, loamy surface layer, C1 horizon, about 10 inches thick. The substratum, C2 horizon, is a gravelly loamy material overlying fractured bedrock. These soils are rapidly permeable; effective rooting depth is 20-36 inches. Available moisture capacity is moderate; surface runoff is rapid and erosion hazard is high.

Sediment yield from this association is 0.5-1.0 acre-feet/square mile/year. These soils are used mainly for range, wildlife, watershed, and small areas of semi-wet pastures in alluvial valleys. The general vegetative type is sagebrush. Reclamation potential is fair to good.

Ustollic Haplargids, loamy Association, Association #10, (255,204 acres)

This association consists of nearly level to gently sloping soils on mesas and terraces (0-9 percent slopes). Elevation ranges from about 5,500-6,200 feet. The average annual precipitation is about 8-10 inches; soil moisture regime is aridic; the average annual soil temperature is less than 47°F but more than 59°F,mesic, and frost-free season is 120-140 days.

The association has about 85 percent Ustollic Haplargids and about 15 percent unidentified minor soils that are salty and scattered throughout the association; these soils are located in the western part of the area.

Ustollic Haplargids are deep well-drained soils over sedimentary rocks. Typically they have a thin, dark-colored, loamy surface layer, A1 horizon, less than 7 inches thick. The subsoil, 10-40 inch layer, B2t horizons, is loamy, with thin clay films on the ped surfaces. The substratum is fractured bedrock. The permeability is moderate; effective rooting depth is 60 inches+. Available water capacity is high; surface runoff is slow, and erosion hazard is high.

Sediment yield from this association is 0.5-3.0 acre-feet/square mile/year. These soils are used for recreation, irrigated cropland, range, and wildlife. The general vegetative type is saltbush-greasewood. Reclamation potential is poor due to excess salts and droughtiness.

Borollic Camborthids, clayey-Aridic Argiborolls, loamy Association, Association #21, (362,445 acres)

This association consists of gently sloping to moderately steep soils on uplands and in valleys (3-25 percent slopes). Elevations range from 6,500-9,000 feet. Average annual precipitation is 15-20 inches; soil moisture regime is aridic; average annual soil temperature is less than 47°F, frigid, and the frost-free season is 100-120 days.

The association has about 70 percent Borollic Camborthids, 25 percent Aridic Argiborolls, and 5 percent of unidentified minor soils located in southeastern Moffat and west-central Routt Counties.

Borollic Camborthids are moderately deep, well-drained soils on residual sedimentary rocks. Typically they have a thin, dark-colored, loamy surface layer, A1 horizon, less than 7 inches thick. The subsoil, 10-36 inch layer, B2 horizon, is a light-colored clayey material, calcareous in the lower part. The substratum is fractured bedrock. This soil has slow permeability; effective rooting depth is 20-40 inches. Available water capacity is moderate to high; surface runoff is rapid and erosion hazard is high.

Sediment yield from this association is 0.2-1.0 acre-feet/square mile/year. These soils are used for dry cropland, range, wildlife, and small areas of irrigated cropland in stream bottoms. General vegetative type is a combination of mountain shrub and bottom. Reclamation potential is good.

Borollic Vertic Camborthids, clayey Association, Association #23, (63,801 acres)

This association consists of gently sloping to moderately steep soils on uplands and benches (3-25 percent slopes). Elevations range from about 6,500-7,000 feet. Average annual precipitation is 12-15 inches; moisture regime is aridic. Average annual soil temperature at 20 inches is 47°F, frigid; frost-free season is 95-110 days.

The association has about 90 percent Borollic Vertic Camborthids, and about 10 percent unidentified minor soils, northeast of Hayden, and north of Steamboat Springs in Routt County.

Borollic Vertic Camborthids are deep and moderately-deep, well-drained soils on sedimentary rocks. Typically they have dark-colored, clayey surface layers, A1 horizons, less than 7 inches thick, that crack when dry. The subsoil, 10-40 inch layer, B2 horizons, is a clayey material. The substratum is fractured bedrock. Permeability is slow; effective rooting depth is 20-60 inches. Available water capacity is moderate to high; surface runoff is rapid and erosion hazard is high.

Sediment yield from the association is 0.2-1.0 acre-feet/square mile/year. These soils are used for range, dry cropland, and wildlife. General vegetative type is sagebrush. Reclamation potential is fair due to semi-droughtiness.

Lithic Camborthids, loamy-Lithic Ustic Torriorthents, loamy Association, Association #24 (74,661 acres)

The association consists of steep soils on hills, breaks, and canyon walls (25 percent+ slopes). Elevation ranges from about 5,000-7,000 feet. Average annual precipitation is 8-10 inches, and the moisture regime is aridic on south-facing slopes, and ustic on north-facing slopes. Average annual soil temperature at 20 inches is more than 47°F. but less than 59°F, mesic, and frost-free season is about 120-140 days.

The association has about 45 percent Lithic Camborthids, 40 percent of Lithic Ustic Torriorthents, and about 15 percent of unidentified minor soils, located near the city of Rangely in Rio Blanco County.

Lithic Camborthids are shallow, well-drained soils on sedimentary rocks. Typically these soils have a dark-colored, loamy surface layer, A1 horizon, less than 7 inches thick. The subsoil, (10-20 inch layer), B2 horizon, is an altered, light-colored, loamy material that may have free carbonates. The substratum is fractured bedrock. Permeability is slow; effective rooting depth is less than 20 inches. Available water capacity is low-very low; surface runoff is rapid; erosion hazard is high-very high.

Lithic Ustic Torrenthents are shallow, well-drained soils on sedimentary rocks. Typically they have a light-colored loamy surface layer, A1 horizon, less than 7 inches thick. The upper substratum, 10-20 inch layer, C horizon, is a calcareous, loamy material that may be strongly alkaline. The lower substratum is fractured bedrock. Permeability is slow; effective rooting dept is less than 20 inches. Available water capacity is low-very low; surface runoff is rapid and erosion hazard is high-very high.

The sediment yield from the association is 0.5-3.0 acre-feet/square mile/year. These soils are used for range, woodland, wildlife, and watershed. General vegetative type is pinyon-juniper. Reclamation potential is poor due to excess slope and droughtiness.

Entisols

Typic Torriorthents, clayey (shallow) Association, Association #33, (23,077 acres)

This association consists of gently sloping to steep soils on breaks (3-25 percent slopes). Elevation ranges from 5,000-6,000 feet. Average annual precipitation is 8-10 inches; moisture regime is aridic. Average annual soil temperature at 20 inches is more than 47°F, but less than 59°F, mesic, and frost-free season is about 120-140 days.

The association has about 90 percent Typic Torriorthents and about 10 percent of unidentified minor soils; they are located at Rangely in Rio Blanco County.

Typic Torriorthents are shallow, well-drained soils on sedimentary rocks. Typically they have a light-colored, calcareous, salty, clayey surface layer, A1 horizon, less than 7 inches thick. The substratum, 7-20 inch layer, C horizon, is a light-colored, calcareous, salty, and clayey material. The underlying material is fractured shale. Permeability is slow; effective rooting depth is less than 20 inches. Available water capacity is low-very low; surface runoff is rapid-very rapid; erosion hazard is high-very high.

The sediment yield from this association is 1.0-3.0 acre-feet/square mile/year. These soils are mainly used for urban development, range, and wildlife. General vegetative type is saltbush. Reclamation potential is poor due to excess salts and droughtiness.

Ustic Torriorthents, loamy-Borollic Camborthids, loamy Association, Association #34, (416,743 acres)

This association consists of gently sloping to moderately steep soils on alluvial fans and floodplains (3-25 percent slope). Elevation ranges from 6,000-7,000 feet. Average annual precipitation is 8-12 inches, and the soil moisture regime is torric bordering on ustic. Average annual soil temperature at 20 inches is less than 47°F, and the difference between summmer and winter temperatures is more than 9°F, frigid. Frost-free season is 100-120 days.

The association has about 50 percent Ustic Torriorthents, 45 percent Borollic Camborthids, and 5 percent of unidentified minor soils, located in the north-central part of Moffat County.

Ustic Torriorthents are deep, well-drained soils on alluvial fans. Typically these soils have a light-colored, calcareous, salty, loamy surface layer, A1 horizon, less then 7 inches thick. The substratum, 7-40 inch layer, C horizons, is a light-colored, calcareous, salty, and loamy material. Permeability is rapid; effective rooting depth is 40-60 inches. Available water capacity is high; surface runoff is medium; erosion hazard is high to very high.

Borollic Camborthids are deep, well-drained soils on floodplains. Typically they have a dark-colored, loamy surface layer, A1 horizon, about 10 inches thick. The subsoil, (10-40 inch layer), has a light-colored, altered, B2 horizon, loamy material, calcareous in the lower part. The substratum, 40-60 inch layer, C horizon, is a calcareous loamy material. Permeability is slow; effective rooting depth is 40-60 inches. Available water capacity is high; surface runoff is medium; erosion hazard is high-very high.

Sediment yield from this association is 0.5-3.0 acre-feet/square mile/year. These soils are used mainly for range and wildlife. General vegetative type is saltbush on the Torriorthents and sagebrush on the Camborthids. Reclamation potential is poor due to droughtiness and excess salts.

Ustic Torriorthents, loamy, frigid-Aridic Argiborolls, loamy Association, Association #35, (1,140,275 acres)

This association consists of nearly level to moderately steep soils on plains or mesas (0-25 percent slopes). Elevations range from 6,000-7,500 feet. The average annual precipitation is 12-15 inches; soil moisture regime is aridic bordering on ustic. Average annual soil temperature is less than 47°F, frigid, and the frost-free season is 60-90 days.

The association has about 60 percent Ustic Torriorthents, 20 percent Aridic Argiborolls, and 20 percent of unidentified minor soils scattered throughout. These soils are located in the north-central area from the Utah State line to Craig, in Moffat County.

Ustic Torriorthents are deep, well-drained soils in mixed alluvium form, from sedimentary rocks. Typically Ustic Torriorthents have a light-colored loamy surface layer, A1 horizon, about 10 inches thick. The substratum, 10-40 inch layer, C1 horizon, is a light-colored, loamy material about 24 inches thick. The underlying layer, C2 horizon, is a light-colored, calcareous, loamy material extending to 40 inches+. Hard bedrock is 40-60 inches+.

Ustic Torriorthents are moderately permeable; effective rooting depth is 40-60 inches. Available water capacity is high and available moisture is influenced by spring and late summer rains; June and July are the driest months. Surface runoff is slow, and erosion hazard is moderate.

Aridic Argiborolls are deep, well-drained soils over sandstone and shale, formed in residuum from sedimentary rocks. Typically Aridic Argiborolls have a dark-colored, loamy surface layer, A1 horizon, about 10 inches thick. The subsoil, 10-40 inch layer is loamy material with thin clay films on ped surfaces, B2t horizon. Hard bedrock is 40-60 inches.

Aridic Argiborolls are moderately permeable; effective rooting depth is 40-60 inches. Available water capacity is high; available moisture is influenced by spring and late summer rains; June and July are the driest months. Surface runoff is slow, and erosion hazard is low.

The sediment yield from this association is 0.2-1.0 acre-feet/square mile/year. These soils are used for range, dry cropland, irrigated cropland, community development, wildlife, recreation, and watershed. General vegetative type is sagebrush with scattered areas of saltbush. Reclamation potential is good.

Lithic Ustic Torriorthents, loamy-Ustic Torriorthents, loamy Association, Association #41, (358,372 acres)

This association consists of moderately steep and steep soils on mesas and breaks (15-25+ percent slopes). Elevation ranges from 6,000-7,500 feet. Average annual precipitation is 12-15 inches. The soil moisture regime is torric bordering on ustic, where rainfall occurs during early spring and late summer months. Average annual soil temperature is less than 47°F and the difference between summer and winter temperatures is more than 9°F, frigid; frost-free season is 100-120 days.

The association has about 65 percent Lithic Ustic Torriorthents, 30 percent Ustic Torriorthents, and 5 percent of unidentified minor soils, located in the western part of Moffat County.

Lithic Ustic Torriorthents are shallow, well-drained soils on sedimentary rocks. Typically they have a light-colored, loamy surface layer, A1 horizon, less than 7 inches thick. The substratum, 7-20 inch layer, C horizon, is a light-colored, loamy material overlying fractured bedrock. Permeability is rapid; effective rooting depth is less than 20 inches. Available water capacity is low-very low; surface runoff is rapid; and erosion hazard is moderate-high.

Ustic Torriorthents are moderately deep, well-drained soils on sedimentary rocks. Typically, these soils have a light-colored, loamy surface layer, A1 horizon, less than 7 inches thick. The substratum, 10-40 inch layer, C horizons, is a light-colored, calcareous, loamy material overlying fractured sedimentary bedrock. Permeability is moderate; effective rooting depth is 20-40 inches. Available water capacity is moderate-high; surface runoff is rapid, and erosion hazard is moderate-high.

Sediment yield from this association is 0.2-1.0 acre-feet/square mile/year. These soils are mainly used for range, recreation, and wildlife. General vegetative type is sagebrush-grass and scattered pinyon-juniper. Reclamation potential is good.

Lithic Ustic Torriorthents, loamy-Rock Outcrop Association, Association #42 (143,891 acres)

This association consists of moderately-steep to steep soils on breaks and canyon walls (15-25+ percent slopes). Elevation ranges from 5,000-8,000 feet. Average precipitation is 8-15 inches; soil moisture regime is ustic where rainfall occurs during early spring and late summer months. Average annual soil temperature is more than 47°F, but less than 59°F, mesic; frost-free season is 100-140 days.

The association has about 60 percent Lithic Ustic Torriorthents and 40 percent Rock Outcrop. These soils and land type are located along the Utah State line west of Rangely in Rio Blanco County, and in the northwest part of MOffat County.

Lithic Ustic Torriorthents are shallow, well-drained soils on sedimentary rocks. Typically they have a light-colored, loamy surface layer, Al horizon, less than 7 inches thick. The substratum, 7-20 inch layer, C horizon, is a light-colored, loamy material overlying fractured bedrock. Permeability is moderate; effective rooting depth is less than 20 inches. Available water capacity is low-very low; surface runoff is rapid and erosion hazard is high. Rock outcrop consists of exposures of bare rock.

The sediment yield from this association is 0.5-3.0 acre-feet/square mile/year. These soils are used mainly for wildlife, range, and woodland. General vegetative type is pinyon-juniper. Reclamation potential is poor due to excess slope, rock outcrop and semi-droughtiness.

Ustic Torripsamments Association, Association #45, (50,226 acres)

This association consists of gently-sloping to moderately-steep soils on upland (3-25 percent slopes). Elevation ranges from 6,000-6,500 feet. Average precipitation is 12-15 inches; soil moisture regime is torric bordering on ustic where rainfall occurs during early spring and late summer months. Average annual soil temperature is less than 47°F, and the difference between summer and winter temperature is more than 9°F, frigid; frost-free season is 100-120 days.

The association has about 95 percent Ustic Torripsamments and 5 percent of unidentified minor soils located west of Maybell in Moffat County. These soils are deep excessively-drained soils on sandy plains. Typically they have a light-colored sandy surface layer, Al horizon, less than 7 inches thick. The substratum, 10-40 inch layer, C horizon, is a light-colored sandy material. Permeability is rapid; effective rooting depth is 40-60 inches. Available water capacity is low; surface runoff is slow; wind erosion hazard is high.

Sedimentation yield from this association is 0.1-0.2 acre-feet/square mile/year. These soils are used mainly for range and wildlife. General vegetative type is bitterbush. Reclamation potential is fair due to droughtiness.

Inceptisols

Pergelic Cryumbrepts, sketetal-Pergelic Cryochrepts, skeletal-Rock Association, Association #47, (21,720 acres)

This association consists of sloping to steep soils on high mountain ridges and peaks (8-25+ percent slopes). Elevations range from about 11,000-12,000+ feet. Average annual precipitation is more than 24 inches and falls mostly as snow; soil moisture regime is udic, i.e., never dry; the soil has a permafrost or thaws in summer, if rock is between 50 centimeters to one meter of the surface. Annual soil temperature is less than 32°F, pergelic, and frost- free season is less than 30 days.

This association is about 45 percent Pergelic Cryumbrepts, skeletal, 35 percent Pergelic Cryochrepts, skeletal; and 20 percent Rock Outcrop, located along the eastern edge of Routt County.

Pergelic Cryumbrepts, and Pergelic Cryochrepts are deep, well-drained soils formed in sedimentary rocks and are found over residuum. Rock Outcrop consists of exposures of bare rock.

Sediment yield from this association is very low, less than 0.1 acre-feet/square mile/year. These soils have a poor potential for low buildup. Their principal limiting soil features are steep slopes, permafrost, and the presence of stones and Rock Outcrop. The potential for frost heave is not rated, but mass wasting is prevalent; deep cuts along uphill side of roads can cause exposures of bare rock, thaw the permafrost, and cause the slope to fail. Large volumes of coarse fragments cause excavation problems; opportunities for topsoil are poor because of steep slopes and coarse fragments. These soils are used for woodland, recreation, and watershed and wildlife. Reclamation potential is poor due to slope, coarse fragments, and a very short growing season.

Mollisols

Aridic Argiborolls, clayey-Aridic Haploborolls, clayey Association, Association #52, (51,584 acres)

This association consists of sloping to steep soils on mountain slopes (9-25 percent slopes). Elevation ranges from 6,000-8,000 feet. Average annual precipitation is 14-20 inches; the moisture regime is ustic. Average annual soil temperature is less than 47°F, and the difference between summer and winter temperatures is more than 9°F, frigid; frost-free season is 100-130 days.

The association has about 60 percent Aridic Argiborolls, 20 percent Aridic Haploborolls, and 10 percent of unidentified minor soils, near Meeker in Rio Blanco County.

Aridic Argiborolls are moderately-deep, well-drained soils on clayey sedimentary rocks. Typically they have a dark-colored, clayey surface layer, Al horizons, 7-20 inches thick, that does not crack to the surface. The subsoil, 10-40 inch layer, B2t horizon, is a light to dark-colored, clayey material, with thin clay films on the ped surfaces. The substratum is fractured bedrock (shale). Permeability is slow; effective rooting depth is 20-40 inches. Available water capacity is moderate-high; surface runoff is rapid; erosion hazard is high-very high.

Aridic Haploborolls are deep, well-drained soils on clayey sedimentary rocks. Typically they have a dark-colored, clayey surface layer, Al horizon, 7-20 inches thick, that becomes dry during the growing season. The subsoil, 10-40 inch layer, B2 horizons, is a dark to light-colored, clayey material. The substratum is fractured bedrock (shale). Permeability is slow; effective rooting depth ranges from less than 20 inches to 40+. Available water capacity is low to high; surface runoff is rapid; erosion hazard is high-very high. Sedimentation yield from this association is 0.5-1.0 acre-feet/square mile/year. These soils are used mainly for urban developments, range, and wildlife. General vegetative type is pinyon-juniper. Reclamation potential is fair due to excess slope.

Typic Cryoborolls, loamy-Rock Outcrop Association, Association #55, (139,819 acres)

This association consists of sloping to steep soils on mountain slopes and benches (9-25 percent slopes). Elevation ranges from 7,000-9,000 feet. Average annual precipitation is 12-15 inches; moisture regime is ustic. Average annual soil temperature is more than 32°F but less than 47°F, cryic; frost-free season is 30-90 days.

The association has about 60 percent Typic Cryoborolls, 30 percent Rock Outcrop, and 10 percent of unidentified minor soils, located near Yampa and Round Mountain in Routt County.

Typic Cryoborolls are shallow, well-drained soils on loamy sedimentary rocks. Typically they have a dark-colored, loamy surface layer, Al horizon, 7-20 inches thick. The subsoil, B2 horizon, 10-20 inch layer, is an altered loamy material over bedrock. Permeability is moderate; effective rooting depth is less than 20 inches. Available water capacity is very-low low; surface runoff is slow; erosion hazard is low. Rock Outcrop consists of exposures of bare rock.

Sediment yield from this association is 0.1-0.2 acre-feet/square mile/year. These soils are mainly used for range and wildlife. General vegetative type is sagebrush. Reclamation potential is poor due to Rock Outcrop and coarse fragments.

Typic Cryoborolls, clayey-Typic Cryoboralfs, skeletal Association #56, (19,005 acres

This association consists of moderately steep and steep soils on mountain slopes (15-25+ percent slopes). Elevation ranges from 6,000-8,000 feet. Average annual precipitation is 12-20 inches; moisture regime is ustic. Average annual soil temperature is higher than 32°F. but less than 47°F, (cryic); frost-free season is 60-90 days.

The association has about 60 percent Typic Cryoborolls, 30 percent Typic Cryoboralfs, and 10 percent of unidentified minor soils, located northwest of Meeker in Rio Blanco County.

Typic Cryoborolls are deep, well-drained minor soils on clayey sedimentary rocks. Typically they have a dark-colored, clayey surface layer, A1 horizons, 7-20 inches thick. The substratum 10-40 inch layer, C horizon, is a light-colored, clayey material; it is fractured shale bedrock. Permeability is slow; effective root depth is 40 inches+. Available water capacity is moderate-high; surface runoff is rapid and erosion hazard is moderate.

Typic Cryoboralfs are shallow to deep well-drained soils on sedimentary rocks. Typically these soils have a light-colored, gravelly surface, A1 horizon; less than 7 inches below the subsoil, 10-40 inch layer, B2t horizon, is light-colored, very gravelly, loamy material with thin clay film on ped surfaces; substratum is fractured bedrock. Permeability is slow; effective rooting depth is 10-60+ inches. Available water capacity is low to moderate; surface runoff is rapid and erosion hazard is moderate.

Sediment yield from this association is 0.2-0.5 acre-feet/square mile/year. These soils are used for range and wildlife. General vegetative type is mountain shrub and pinyon-juniper. Reclamation potential is poor due to coarse fragments and excess slope.

Typic Cryoborolls, clayey-Typic Cryorthents, clayey association, Association #57, (63,803 acres)

This association consists of moderately steep and steep soils on benches and mountain slopes (15 to 25+ percent slopes). Elevation ranges from 8,000-9,000 feet. Average annual precipitation is 12-15 inches; moisture regime is ustic; average annual soil temperature is more than 32°F but less than 47°F, cryic; frost-free season is 60-90 days.

The association has about 45 percent Typic Cryoborolls, 25 percent Typic Cryorthents, 20 percent Rock Outcrop, and 10 percent of unidentified minor soils; they are located in northern and southern parts of Routt and northeast part of Moffat County.

Typic Cryoborolls are deep, well-drained soils on clayey sedimentary rocks. Typically they have a dark-colored, clayey surface layer, A1 horizon, 7-20 inches thick. The subsoil, 10-40 inch layer, B2 horizon, is light-colored in the lower part; substratum is fracture shale bedrock. Permeability is slow; effective rooting depth is 40 inches+. Available water capacity is high; surface runoff is rapid and erosion hazard moderate.

Typic Cryorthents are shallow, well-drained soils on clayey sedimentary rocks. Typically they have a light-colored, clayey surface layer, A1 horizon, less than 7 inches thick. The substratum, 10-40 inch layer, C horizon, is light-colored, clayey material overlying a soft shale. Permeability is moderate; effective rooting depth is less than 20 inches. Available water capacity is low; surface runoff is rapid and erosion hazard moderate. Rock Outcrop consists of exposed bare rock.

Sediment yield from this association is 0.2-0.5 acre-feet/square mile/year. These soils are mainly used for range, recreation, subdivision, and irrigated cropland. General vegetative group is sagebrush-grass. Reclamation potential is good-poor, due to a combination of excess slope and coarse fragments, or Rock Outcrop.

Argic Cryoborolls, loamy-Cryic Paleoborolls, loamy association, Association #59, (496,834 acres)#59,

This association consists of sloping to steep soils on mountain slopes (9 to 25+ percent slopes). Elevation ranges from 7,000-8,000 feet. Average annual precipitation is 15-20 inches; moisture regime is ustic. Average annual soil temperature is more than 32°F but less than 47°F, cryic; frost free season is less than 90 days.

The association has about 55 percent Argic Cryoborolls, 40 percent Cryic Paleoborolls, and 5 percent of unidentified minor soils located in the eastern and northwestern part of the study area.

Argic Cryoborolls are shallow, well--drained soils on loamy sedimentary rocks. Typically they have a dark-colored, loamy surface layer, A1 horizon, 7-20 inches thick. The subsoil, 10-20 inch layer, B2 horizons, is light-colored in the lower part, and has thin clay films on ped surfaces; substratum is fractured bedrock. Permeability is slow; effective rooting depth is less than 20 inches. Available water capacity is low-moderate; surface runoff is slow and erosion hazard slight.

Cryic Paleoborolls are deep, well-drained soils on basaltic and sedimentary rocks. Typically they have a dark-colored, loamy surface layer, 10-20 inches thick. The subsoil, 10-40 inch layer, B2 horizon, has a clay accumulation in the 24-40 inch layer, B^{1}2t horizon; substratum is loamy soil material above the bedrock. Permeability is moderate; effective rooting depth is 60 inches+. Available water capacity is high; surface runoff is slow, and erosion hazard slight.

Sediment yield from this association is 0.1-0.2 acre-feet/square mile/year. These soils are used for range, wildlife, irrigated cropland, and watershed. General vegetative group is mountain shrub-sagebrush. Reclamation potential is fair-poor due to excess slope.

Lithic Haploborolls, skeletal-Rock outcrop Association, Association #61, (9,502 acres)

This association consists of moderately steep and steep soils on mesas and breaks (15 to 25+ percent slopes). Elevation ranges from 7,000-8,000 feet. The average annual precipitation is 15-20 inches; moisture regime is ustic. Average annual soil temperature is more than 32°F but less than 47°F, cryic; frost-free season is less than 90 days.

The association has about 60 percent Lithic Haploborolls and 40 percent Rock Outcrop, located near Meeker in Rio Blanco County.

Lithic Haploboralfs are shallow, well-drained soils on sedimentary rocks. Typically they have light-colored, very gravelly surface layers, A1 horizons, less than 7 inches thick. The subsoil, 10-20 inch layer, B2 horizon, is a very gravelly soil material over fractured sedimentary rocks. Permeability is moderate; effective rooting depth is less than 20 inches. Available water capacity is low; surface runoff is medium and erosion hazard moderate. Rock Outcrop consists of exposures of bare rock. Sediment yield from this association is 0.5-1.0 acre-feet/square mile/year. The soils are used mainly for range and wildlife. General vegetative group is mountain shrub-aspen. Reclamation potential is poor, due to excess slope and coarse fragments, or Rock Outcrop.

Typic Paleborolls, clayey-Borollic Camborthids, clayey Association, Association #62, (141,177 acres)

This association consists of gently sloping to moderately steep soils on uplands (3-25 percent slopes). Elevation ranges from 6,500-8,000 feet. Average annual precipitation is 15-20 inches; moisture regime is ustic. Average annual soil temperature is less than 47°F but the summer temperature is less than 59°F, frigid; frost-free season is 90-110 days.

The association has about 55 percent Typic Paleborolls, 35 percent Borollic Camborthids, and 10 percent of unidentified minor soils; these soils are located in the central part of Routt County near Steamboat Springs.

Typic Paleborolls are deep, well-drained soils on clayey sedimentary rocks. Typically they have a dark-colored, clayey surface layer, A1 horizon, 7-20 inches thick. The next layer is light-colored, A2 horizon, overlying a clayey B^{1}2t horizon that consists of thick clay films on ped surfaces extending 60 inches or more to weathered shale bedrock. Permeability is slow; effective root depth is 60 inches+. Available water capacity is high; surface runoff is medium. and erosion hazard moderate.

Borollic Camborthids are deep, well-drained soils on clayey sedimentary rocks. Typically they have a dark-colored, clayey surface layer, A1 horizon, about 7 inches thick. The subsoil, 10-40 inch layer, B2 horizon, is a light-colored, clayey soil material extending from 40-60 inches; substratum is soft shale bedrock.

Permeability is slow; effective rooting depth is 40-60 inches. Available water capacity is high; surface runoff is medium and erosion hazard moderate.

Sediment yield from this association is 0.2-0.5 acre-feet/square mile/year. These soils are used mainly for range, wildlife, and dry cropland, with some irrigated pasture in the narrow bottoms. General vegetative group is mountain shrub-bottom. Reclamation potential is good.

TABLE VII-1

Environmental Characteristics Important to Soil Formation and Reclamation

Soil Map Symbol	Textural Family[1]	M.A.P.[20] (inches)	Soil Temp. Regime	Growing Season (days)	Elevation (1000 feet)	Nat. Veg.[17]	Land-form[19]	Sediment Yield[6]	Reclamation Potential[18]	Present Use[16]
1	skeletal[2]	20+	cryic[7]	30-45	8-11	c	ma-ms	< 0.1	p[10,11]	WL,WE,RC
9	loamy[3]	12-15	frigid[8]	60-90	6-8	s	fh-fn	0.5-1.0	f-g	RE,WE,PE
10	loamy	8-10	mesic[9]	120-140	5.5-6.2	s-g	ma-te	0.5-3.0	p[12,13]	RC,IC,RE
21	clayey[4]-loamy	15-20	frigid	100-120	6.5-9	m-b	up-vy	0.2-1.0	g	DC,IC,RE
23	clayey	12-15	frigid	95-110	6.5-7	s	up-be	0.2-1.0	f[14]	RE,DC,WE
24	loamy	8-10	mesic	120-140	5-7.5	p-j	fh-br-cy	0.5-3.0	p[11,13]	RE,WL,WE
33	clayey	8-10	mesic	120-140	5-6	t	br	1.0-3.0	p[12,13]	RE,UD,RC
34	loamy	8-12	frigid	100-120	6-7	t-s	fn-fp	0.5-3.0	p[12,13]	RE,RC,WE
35	loamy	12-15	frigid	60-90	6.5-8	s	up	0.2-1.0	g	UD,RC,WE
41	loamy	12-15	frigid	100-120	6-7.5	s-p-j	ma-br	0.2-1.0	f-g	RE,RC,WE
42	loamy	8-15	mesic	100-140	5-8	p-j	br-cy	0.5-3.0	p[10,11,14]	WE,RE,WL
45	sandy[5]	12-15	frigid	100-120	6-6.5	u	up	0.1-0.2	f[13]	WE,RE
47	skeletal	20+	pergelic[15]	<30	>11	c	mt	<0.1	p[10,11]	RC,WS
52	clayey	14-20	frigid	100-130	6-8	p-j	ms	0.5-1.0	f[11]	UD,RE,WE

Footnotes 1-20 see pages VII-25-26.

Soils

TABLE VII-1 (Cont.)

Map Symbol	Textural Family[1]	M.A.P. (inches)	Soil Temp. Regime	Growing Season (days)	Elevation (1000 feet)	Nat. Veg.[17]	Land-form[19]	Sediment Yield[6]	Reclamation Potential[18]	Present Use[16]
55	loamy	12-15	cryic	30-90	7-9	s	ms-be	0.1-0.2	p[10]	RE,WE
56	clayey-skeletal	12-20	cryic	60-90	6-8	m-p-j	ms	0.2-0.5	p[10,11]	RE,WE
57	clayey	12-15	cryic	60-90	8-9	s-r	be-ms	0.2-0.5	g-f[11]	RE,IC,UD
59	loamy	12-20	frigid	<90	7-8.5	m-s	ms	0.1-0.2	f-p[11]	RE,IC,WE
61	skeletal	15-20	frigid	<90	7-8	m-a	me-br	0.5-1.0	p[10,11]	RE,DC,WE
62	clayey	15-20	frigid	90-110	6.5-8	m-b	up	0.2-0.5	g	RC,WS

[1] Assume well-drained soil material (10-40 inch layer).

[2] <35% by volume is larger than 2 mm.

[3] Texture is loamy, very fine sand or finer <35% clay, less than 35% by volume of rock fragments.

[4] Texture has > 35% by weight of clay, <35% by volume of rock fragments.

[5] Texture is sand or loamy sand, <35% by volume of rock fragments.

[6] Acre-feet per square mile per year. (Reference: Colorado Land Use Commission, 1974).

[7] Mean annual soil temperature is >32°F but <47°F.

[8] Mean annual soil temperature is <47°F and >32°F; difference between mean summer and mean winter is >9°F.

[9] Mean annual soil temperature is 47°F-59°F.

TABLE VII-1 (Cont.)

[10] Coarse fragment.

[11] Excess slope.

[12] Excess salts.

[13] Droughty.

[14] Semi-droughty.

[15] Mean annual soil temperature is <32°F.

[16] DC, dry cropland; IC, irrigated cropland; PE, pasture; RC, recreation; RE, range; UD, urban development & subdivision; WE, wildlife; WL, woodland; WS, watershed.

[17] a, aspen; b, bottom; c, conifer; g, greasewood; j, juniper; m, mountain shrub; p, pinyon; r, grass; s, sagebrush; t, saltbush; u, bitterbrush.

[18] g, good; f, fair; p, poor.

[19] be, bench; br, break; cy, canyon; fh, foothill; fn, fan; fp, floodplain; ma, mesa; ms, mountain slope; mt, mountain top; te, terrace; up, upland; vy, valley.

[20] M.A.P. mean annual precipitation.

TABLE VII-2

Estimated Soil Properties Significant to Engineering and Their Interpretations

Soil Association Number, Name and Components	Extent %	Slope %	Bedrock (inches)	Perm- eability	Shrink Swell Potential	Frost Action Potential	Degree and Kind of Limitation for -- Septic Tank Filter-Field	Degree and Kind of Limitation for -- Low Buildings W/O Basement	Suitability As A Source of -- To a depth of 5 feet Road Fill	Suitability As A Source of -- To a depth of 5 feet Sand & Gravel
1 Typic Cryoboralfs, skeletal - Rock outcrop										
Typic Cryoboralfs, skeletal	70	9-25	20-60	Rapid	Low	Moderate	Severe^{6,8}	Severe^{6,8}	Fair^{6,8}	Unsuited
Rock outcrop	20	-	0	-	-	-	Severe^{11}	Severe^{11}	Poor^{11}	Unsuited
Minor soils	10	-	-	-	-	-	-	-	-	-
9 Borollic Haplargids, loamy - Ustic Torriorthents, loamy										
Borollic Haplargids, loamy	60	15-25	<20	Rapid	Low	Low	Severe^{6,8}	Severe^{6}	Poor^{6}	Unsuited
Ustic Torriorthents, loamy	20	3-15	40-60	Rapid	Low	Low	Moderate^{6}	Moderate^{6,8}	Fair^{14}	Unsuited
Argiborolls, loamy	15	-	-	-	-	-	-	-	-	-
Minor soils	5	-	-	-	-	-	-	-	-	-
10 Ustollic Haplargids, loamy										
Ustollic Haplargids, loamy	85	3-15	>60	Moderate	Moderate	Low	NR	NR	NR	Unsuited
Minor soils (Camborthids?)	15	3-15	>60	Moderate	Moderate	Low	Slight	Moderate^{8}	Fair^{14}	Unsuited
21 Borollic Camborthids, clayey - Aridic Argiborolls, loamy										
Borollic Camborthids, clayey	70	3-25	20-40	Slow	High	Moderate	Severe^{1}	Severe^{13}	Poor^{13,14}	Unsuited
Aridic Argiborolls, loamy	25	3-25	20-60	Slow	High	Moderate	Severe^{1}	Severe^{13}	Poor^{13,14}	Unsuited
Minor soils	5	-	-	-	-	-	-	-	-	-
23 Borollic Vertic Camborthids, clayey										
Borollic Vertic Camborthids, clayey	90	3-25	20-60	Slow	High	Moderate	Severe^{1}	Severe^{12,14}	Poor^{13,14}	Unsuited
Minor soils	10	-	-	-	-	-	-	-	-	-

Footnotes: See page VII-31.

TABLE VII-2 (Cont.)

Estimated Soil Properties Significant to Engineering and Their Interpretations

Soil Association Number, Name and Components	Extent %	Slope %	Bedrock (inches)	Perm-eability	Shrink Swell Potential	Frost Action Potential	Degree and Kind of Limitation for -- Septic Tank Filter-Field	Degree and Kind of Limitation for -- Low Buildings W/O Basement	Suitability As A Source of -- Road Fill (To a depth of 5 feet)	Suitability As A Source of -- Sand & Gravel (To a depth of 5 feet)
24 Lithic Camborthids, loamy - Lithic Ustic Torriorthents, loamy										
Lithic Camborthids, loamy	45	15-25+	<20	Slow	Low	Low	Severe[8,11]	Severe[8,11]	Poor[8]	Unsuited
Lithic Ustic Torriorthents, loamy	40	15-25+	<20	Slow	Low	Low	Severe[8,11]	Severe[8,11]	Poor[8]	Unsuited
Minor soils	15	-	-	-	-	-	-	-	-	-
33 Typic Torriorthents, clayey (shallow)										
Typic Torriorthents, clayey (shallow)	90	3-25	20	Slow	High	Low	Severe[6,8,13]	Severe[6,8,13]	Poor[8,14]	Unsuited
Minor soils	10	-	-	-	-	-	-	-	-	-
34 Ustic Torriorthents, loamy - Borollic Camborthids, loamy										
Ustic Torriorthents, loamy	50	3-25	40-60	Rapid	Low	Low	Moderate[6,8]	Moderate[8]	Fair[8,14]	NR
Borollic Camborthids, loamy	45	3-25	40-60	Slow	High	Low	Severe[1]	Severe[13,14]	Poor[13,14]	Unsuited
Minor soils	5	-	-	-	-	-	-	-	-	-
35 Ustic Torriorthents, loamy - Aridic Argiborolls, loamy										
Ustic Torriorthents, loamy	60	3-9	40-60	Moderate	Low	Moderate	Moderate[6]	Slight	Fair[14]	NR
Aridic Argiborolls, loamy	20	0-9	40-60	Moderate	Low	Moderate	Moderate[6]	Slight	Fair[14]	NR
Minor soils	20	0	0	0	0	-	-	-	-	-
41 Lithic Ustic Torriorthents, loamy - Ustic Torriorthents, loamy										
Lithic Ustic Torriorthents, loamy	65	15-25+	<20	Rapid	Low	Low	Severe[6,8]	Severe[6,8]	Poor[6,8]	Unsuited
Ustic Torriorthents, loamy	30	15-25	20-40	Moderate	Low	Low	Severe[8]	Severe[8]	Poor[8]	Unsuited
Minor soils	5	-	-	-	-	-	-	-	-	-

Footnotes: See page VII-31.

Soils

TABLE VII-2 (Cont.)

Estimated Soil Properties Significant to Engineering and Their Interpretations

Soil Association	Extent	Slope	Bedrock	Perm-	Shrink Swell	Frost Action	Degree and Kind of Limitation for --		Suitability As A Source of --	
Number, Name and Components	%	%	(inches)	eability	Potential	Potential	Septic Tank Filter-Field	Low Buildings W/O Basement	Road Fill	Sand & Gravel
									To a depth of 5 feet	
42 Lithic Ustic Torriorthents, loamy - Rock outcrop										
Lithic Ustic Torriorthents, loamy	60	15-25	<20	Moderate	Low	Low	Severe^{6,8}	Severe^{6,8}	Poor^{6,9}	Unsuited
Rock outcrop	40	-	0	-	-	-	Severe^{11}	Severe^{11}	Poor^{11}	Unsuited
45 Ustic Torripsamments										
Ustic Torripsamments	95	3-15	40-60	Rapid	Low	Low	Slight^{7}	Slight	Good	Good for sand
Minor soils	5	-	-	-	-	-	-	-	-	Unsuitable for gravel
47 Pergelic Cryumbrepts, skeletal - Pergelic Cryochrepts, skeletal - Rock outcrop										
Pergelic Cryumbrepts, skeletal	45	9-25+	60+	NR	NR	NR	Severe^{8}	Severe^{8}	NR	Unsuited
Pergelic Cryochrepts, skeletal	35	9-25+	60+	MR	NR	NR	Severe^{8}	Severe^{8}	NR	Unsuited
Rock outcrop	20	-	-	-	-	-	-	-	-	-
52 Aridic Argiborolls, clayey - Aridic Haploborolls, clayey										
Aridic Argiborolls, clayey	60	9-25	<20-40+	Slow	High	Moderate	Severe^{1,6,8}	Severe^{8,13}	Poor^{13,14}	Unsuited
Aridic Haploborolls, clayey	30	9-25	20-40+	Slow	Moderate	Moderate	Severe^{6,8}	Severe^{6,8}	Poor^{6}	Unsuited
Rock outcrop	10	-	0	-	-	Severe^{11}	Severe^{11}	Severe^{11}	Poor^{11}	Unsuited
55 Typic Cryoborolls, loamy - Rock outcrop										
Typic Cryoborolls, loamy	60	9-25	<20	Moderate	Low	Low	Severe^{6}	Severe^{6,8}	Poor^{6,11}	Unsuited
Rock outcrop	30	-	0	-	-	-	Severe^{11}	Severe^{11}	Poor^{11}	Unsuited
Minor soils	10	-	-	-	-	-	-	-	-	-

Footnotes: See page VII-31.

TABLE VII-2 (Cont.)

Estimated Soil Properties Significant to Engineering and Their Interpretations

Soil Association Number, Name and Components	**Extent %**	**Slope %**	**Bedrock (inches)**	**Perm-eability**	**Shrink Swell Potential**	**Frost Action Potential**	**Degree and Kind of Limitation for -- Septic Tank Filter-Field**	**Degree and Kind of Limitation for -- Low Buildings W/O Basement**	**Suitability As A Source of -- Road Fill To a depth of 5 feet**	**Suitability As A Source of -- Sand & Gravel To a depth of 5 feet**
56 Typic Cryoborolls, clayey - Typic Cryoboralfs, skeletal										
Typic Cryoborolls, clayey	60	15-25+	>40	NR	NR	NR	Severe^{8}	Severe^{8}	NR	Unsuited
Typic Cryoboralfs, skeletal	30	15-25+	10-60+	NR	NR	NR	Severe^{8}	Severe^{8}	NR	Unsuited
Rock outcrop	10	-	0	-	-	-	Severe^{11}	Severe^{11}	Poor^{11}	Unsuited
57 Typic Cryoborolls, clayey - Typic Cryorthents, clayey										
Typic Cryoborolls, clayey	45	15-25+	>40	NR	NR	Moderate	Severe^{8}	Severe^{8}	NR	Unsuited
Typic Cryorthents, clayey	25	25+	<20	Moderate	Low	Moderate	Severe^{6,8,11}	Severe^{6,8,11}	Poor	Unsuited
Rock outcrop	20	-	0	-	-	- ^{11}	Severe^{11}	Severe^{11}	Poor^{11}	Unsuited
Minor Soils	10	-	-	-	-	-	-	-	-	-
59 Argic Cryoborolls, loamy - Cryic Paleoborolls, loamy										
Argic Cryoborolls, loamy	55	3-25	>60	Slow	High	High	Severe^{1,8}	Severe^{8,13}	Poor^{13,14}	Unsuited
Cryic Paleoborolls, loamy	40	9-25+	<20	Moderate	Low	Moderate	Severe^{6,8}	Severe^{6,8}	Poor^{6,8}	-
Minor soils	5	-	-	-	-	-	-	-	-	-
61 Lithic Haploborolls, skeletal - Rock outcrop										
Lithic Haploborolls, skeletal	60	15-25+	20	Moderate	Low	Low	Severe^{6,8}	Severe^{6,8}	Poor^{6,9}	Unsuited
Rock outcrop	40		0	-	-	-	Severe^{11}	Severe^{11}	Severe^{11}	Unsuited
62 Typic Paleborolls, clayey - Borollic Camborthids, clayey										
Typic Paleborolls, clayey	55	3-15	60	Slow	High	High	Severe^{1}	Severe^{13,14}	Poor^{13,14}	Unsuited
Borollic Camborthids, clayey	35	3-25	40-60	Slow	High	High	Severe^{1}	Severe^{13,14}	Poor^{13,14}	Unsuited
Minor soils	10	-	-	-	-	-	-	-	-	-

Footnotes: See page VII-31.

Soils

TABLE VII-2 (Cont.)

Estimated Soil Properties Significant to Engineering and Their Interpretations

[1] Slow permeability

[6] Depth to rock

[7] Possible pollution hazard to water supplies

[8] Excess slope

[9] Coarse fragments

[11] Rock outcrops and/or shallow soils

[13] Shrink-Swell potential

[14] Engineering Soil Classification

NR Not rated because of variability

- Not applicable or information not available

Soil Series Profile Descriptions of the Energy 1 and 2 Expansion Areas

Abor Series

A typical profile of the Abor series located 2,025 feet north and 900 feet east of the southwest corner of Section 22, T.5N., R.87W. is shown below.

A1--0-3 inches, light olive-brown (2.5Y 5/3) silty clay, olive-brown (2.5Y 4/3) moist; strong very fine granular structure; soft, very friable; noncalcareous, mildly alkaline; clear smooth boundary.

B2--3-10 inches, light olive-brown (2.5Y 5/3) silty clay, olive-brown (2.5Y 4/3) moist; moderate coarse angular blocky structure breaking to moderate fine angular blocks; slightly hard, very friable, very plastic; many slickensides; strongly calcareous; moderately alkaline; gradual wavy boundary.

B3--10-18 inches, light olive-brown (2.5Y 5/3) silty clay, olive-brown (2.5Y 4/3) moist; weak to moderate coarse angular blocky structure; hard, very plastic; many slickensides; very strongly calcareous; strongly alkaline; diffuse wavy boundary.

Clca--18-35 inches, light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) moist; massive to very weak coarse angular blocky structure; extremely hard, very plastic; slickensides; calcium carbonate and calcium sulfate occurring as crystals, as concretions, and in thin seams and streaks; very strongly calcareous; stongly alkaline; gradual and wavy boundary.

R--35-60 inches, dark gray calcareous and gypsiferous shale. The principal variations are that depth to the lime layer near surface to 10 inches. The solum is 12-30 inches thick. Bedrock is 20-40 inches deep.

Hub Series

Representative profile of Hub loam in timber, located 2,640 feet east, 1,050 feet south of the northwest corner of Section 1, T.1S., R.84W. is shown below.

A1--0-7 inches, dark grayish-brown (10YR 4/2) loam, very dark-brown (10YR 2/2) moist, weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A2--7-13 inches, light gray (10YR 7/2) loam, dark grayish-brown (10YR 4/2) moist; weak medium prismatic structure that parts to weak medium subangular blocks; soft, very friable; neutral; clear smooth boundary.

B2t--13-24 inches, pale-brown (10YR 6/3) clay loam, dark-brown (10YR 4/3) moist; moderate medium prismatic structure that parts to moderate fine subangular blocks; thin continuous clay films on ped faces; neutral; clear smooth boundary.

C--24-60 inches, very pale-brown (10YR 8/3) loam, pale-brown (10YR 6/3) moist; massive; soft, very friable; neutral.

Mord Series

Described below is a typical profile of Mord loam under native vegetation located near the center of Section 26, T.10N., R.85W. (Routt County)

A11--0-8 inches, grayish-brown (10YR 5/2) loam, very dark-brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; 10 percent gravel; noncalcareous; clear and smooth boundary.

A12--8-14 inches, dark grayish-brown (10YR 4/2) loam, very dark-grayish-brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocks; soft, very friable; 10 percent gravel; noncalcareous; clear smooth boundary.

A2--14-21 inches, brown (10YR 6/3) loam, dark-brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium and fine subangular blocks; soft, very friable; 10 percent gravel; noncalcareous; clear and smooth boundary.

B&A--21-35 inches, pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocks; slightly hard, friable moist; 10 percent gravel; noncalcareous; few mottles of very dark-brown (10YR 2/2); thin and patchy clay films on some ped faces; clear smooth boundary.

B2t--35-60 inches, light-brown (7.5YR 6/4) clay, dark-brown (7.5YR 4/4) moist; strong medium prismatic structure parting to strong fine subangular blocks; hard, firm; 10 percent gravel; thick clay films on ped faces.

Moyerson Series

Shown below is a typical profile of Moyerson clay in native range located 1/4 mile west, 1/4 mile north of the southeast corner of Section 24, T.1N., R.85W.

A1--0-5 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish-brown (2.5Y 3/2) moist; dark grayish-brown (2.5Y 4/2) crushed; moderate to strong fine granular and crumb structure; soft very friable; vesicular crust approximately 1/4 of an inch thick; weakly calcareous, moderately alkaline; clear smooth boundary.

C--5-15 inches, grayish-brown (2.5Y 5/2) silty clay, very dark grayish-brown (2.5Y 4/2) moist; dark grayish-brown (2.5Y 4/2) crushed; very weak fine prismatic structure breaking to strong fine angular blocks; soft to slightly hard; very friable; strongly calcareous, moderately alkaline; gradual wavy boundary.

R--15-20 inches, dark gray clay shale; very strongly calcareous.

Routt Series

A typical profile of Routt loam, from the center of NE 1/4, Section 29, T.6N., R.85W., (Routt County), in native grass.

O1--2-0 inches, very dark-brown organic layer.

A11--0-4 inches, dark gray (10YR 4/1) loam, very dark-brown (10YR 2/2) moist; weak fine platy to weak fine granular structure; soft, very friable; noncalcareous; clean smooth boundary.

A12--4-15 inches, dark gray (10YR 4/1) silt loam, very dark-brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure breaking to weak medium subangular blocks; soft, friable; noncalcareous; clear smooth boundary.

A13--15-22 inches, dark grayish-brown (10YR 4/2) silt loam, very dark-brown (10YR 2/2) moist; soft, very friable; noncalcareous; clear wavy boundary.

A'2--22-30 inches, pale-brown (10YR 6/3) clay loam, dark-brown (10YR 4/3) moist; moderate medium prismatic structures breaking to moderate medium and fine subangular blocks; slightly hard, friable; noncalcareous; about 35 percent of this horizon is very dark-brown material (10YR 2/2); clear wavy boundary.

A'B'--30-37 inches, pale-brown (10YR 6/3) clay loam, dark-brown (10YR 4/3) moist; moderate medium prismatic structure breaking to moderate medium subangular blocks; hard, friable; noncalcareous; 50 percent of this horizon is an A2 coat; clear wavy boundary.

B'A'--37-45 inches, pale-brown (10YR 6/3) clay loam, dark-brown (10YR 4/3) moist; moderate to strong medium prismatic structure breaking to moderate strong medium subangular blocks; hard, firm; noncalcareous; thick continuous clay film; 40 percent of this horizon is an A2 coat; clear wavy boundary.

B'21t--45-56 inches, pale-brown (10YR 6/3) clay loam, dark-brown (10YR 4/3) moist; strong medium prismatic to strong medium subangular blocky structure; hard, firm; noncalcareous; thick continuous clay films; abrupt wavy boundary.

B'22t--56-60 inches, very pale-brown (10YR 6/3) clay loam (10YR 4/3) moist; moderate to strong medium prismatic structure breaking to moderate to strong medium subangular blocks; soft, friable; noncalcareous; thick continuous clay film.

Thickness of the A1 horizon is 16-30 inches. The B'2t is 40-60 inches thick and a clay loam to clay in texture. Hues vary from 7.5YR to 10YR in the B'2t horizon.

Splitro Series

Location of the typical profile is not known.

A1--0-9 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, fine granular structure; soft, very friable; clear smooth boundary.

AC--9-18 inches, dark grayish-brown (10YR 4/2) loam very dark-brown (10YR 2/2) moist; massive; soft, very friable; gradual boundary.

R--18-20 inches, light brownish-gray (10YR 6/2) moist; weathered sandstone.

Bulkley Series

A typical profile of this soil was described 1/4 mile south and 450 feet west of the center of the NE 1/4 of Sec. 14, T.6N., R.88W., in native range, Routt County, Colorado.

A1--0-4"--Grayish brown (2.5Y 5/2) heavy silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate to strong fine granular structure; the horizon is slightly hard dry, very friable moist; weak calcareous, pH 7.8; clear smooth boundary.

B2--4-21"--Grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate to strong coarse prismatic structure breaking to moderate to strong medium angular blocks; the horizon is hard dry, very friable moist, but individual aggregates are extremely hard dry, very plastic when wet; there are many slickensides; calcareous, pH 8.4; gradual wavy boundary.

B3cacs--21-30"--Grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure breaking to weak to moderate coarse angular blocks; the horizon is hard dry, very friable moist, but individual aggregates are extremely hard dry, very plastic wet; many slickensides; this is a weak ca and cs horizon with visible secondary calcium carbonate and calcium sulfate occurring as concretions, in thin seams and streaks, and as crystals; calcareous, pH 8.4; diffuse wavy boundary.

Ccacs--30-42"--Grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; the horizon is very hard to extremely hard dry, very plastic wet; common slickensides; many shale chips; this is a moderate ca and cs horizon with visible secondary calcium carbonate and calcium sulfate occurring as concretions, in thin seams and streaks, and in crystaline forms; calcareous, pH 8.4; diffuse wavy boundary.

R--42-60"--Dark gray calcareous shales.

Cochetopa Series

A representative profile of a Cochetopa clay loam is in the northeast corner of Section 13, T.6N., R.76W.

A1--0-6"--Very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; slightly hard, friable, sticky, plastic; neutral; gradual smooth boundary.

B1--6-18"--Very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; weak and moderate medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few thin patchy clay films occur on ped faces; neutral; gradual smooth boundary.

B21t--18-26"--Dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate and strong medium subangular blocks; very hard, firm, sticky, plastic; thin nearly continuous clay films on ped faces; neutral; clear wavy boundary.

B22t--26-36"--Dark yellowish brown (10YR 4/4) clay, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to moderate and strong medium subangular blocks; extremely hard, very firm, sticky, very plastic; thin continuous clay films on ped faces; neatral; gradual smooth boundary.

B3--36-42"--Yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; extremely hard, firm, sticky, very plastic; thin patchy clay films on ped faces; neutral; 5% gravel and cobble; gradual smooth boundary.

C--42-60"--Yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; massive; extremely hard, firm, sticky, very plastic; neutral.

Delphill Series

A typical profile of Delphill gravelly loam in grass, 0.15 miles south and 0.15 miles west of the center of Sec. 15, T.7N., R.89W.

A1--0-4"--Light brownish gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; 25 percent sandstone channery; non-calcareous; clear smooth boundary.

AC--4-12"--Light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; 10 percent sandstone channery; slightly calcareous; clear smooth boundary.

Cca--12-26"--Light gray (10YR 7/2) gravelly loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; 15 percent sandstone channery; slightly calcareous; clear smooth boundary.

Cr--26-30"--Interbedded sandstone and shale.

Gapo Series

A typical profile (in hayland) is located 0.2 mile east, 2540 feet north of the southwest corner of Sec. 10, T.2N., R.85W. (Routt County):

A0ca--0 to 2 inches; black (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 2/2) when moist; weak, fine, granular structure; soft when dry and very friable when moist; very strongly calcareous; 20 percent of horizon is mottled and gleyed (5Y/5/1, gray); clear, smooth boundary.

A11ca--2 to 20 inches; olive gray (5Y 5/2) clay, dark olive gray (5Y 3/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry and friable when moist; very strongly calcareous; 20 percent of horizon is gleyed (5Y 5/1, gray); clear, smooth boundary.

A12g--20 to 36 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) when moist; massive; slightly hard when dry, friable when moist; strongly calcareous; 20 percent gleyed with gray (5Y 5/1) spots; clear, smooth boundary.

C1g--36 to 60 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) when moist; massive; soft when dry and friable when moist; strongly calcareous with visible lime in streaks and seams in the upper 12 inches; 20 percent of horizon is gleyed with gray (5Y 5/1) spots. In places, material is greenish gray clay (5BG 6/1).

Work Series

A typical profile of this soil was described in the E 1/4 corner of Sec. 8, T.5N., R.84W., Routt County, Colorado. Where examined the soil occurred on a convex slope of 2 percent facing west, and the soil was developing in aeolian sediments. The following is the profile description of the soil as seen:

A11--0-4"--Grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and crumb structure; soft dry, very friable moist; noncalcareous, pH 6.2; clear smooth boundary.

A12--4-11"--Grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak to moderate medium subangular blocky structure breaking to moderate fine granules; the horizon is slightly hard dry, very friable moist, but individual primary aggregates are hard when dry; non-calcareous, pH 6.2; clear smooth boundary.

A2--11-20"--Light brownish gray (10YR 6/2) heavy silt loam, grayish brown (10YR 5/2) moist; moderate medium subangular blocky structure; the horizon is slightly hard dry, very friable moist, but individual aggregates are hard dry; noncalcareous, pH 6.2; diffuse wavy boundary.

B&A--20-30"--Mixed colors ranging from light brownish gray (10YR 6/2) to brown (10YR 5/3) light silty clay loam, grayish brown (10YR 5/2) moist to brown or dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; the horizon is slightly hard dry, very friable moist, but individual aggregates are hard dry; this horizon consists of clayey material like that of the underlying horizon imbedded in a lighter colored matrix like that of the overlying horizon; there are thin nearly continuous clay films on the clayey portions of this horizon; noncalcareous, pH 6.4; gradual smooth boundary.

B2t--30-50"--Brown (10YR 5/3) heavy silty clay loam, brown or dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; the horizon is hard dry, very friable moist, but individual aggregates are very hard dry; there are thin continuous clay films on the surfaces of the aggregates; noncalcareous, pH 6.6.

Horizonation

Typically these soils have an A1, A2, A&B, and B2t horizon sequence. Diagnostically they have mollic epipedons less than 16 inches thick, argillic horizons, and albic horizons that tongue into the argillic horizon. The mean annual soil temperature is 44°F., and the mean summer soil temperature is approximately 58°F., without an O horizon.

Gallatin Series

A typical profile of Gallatin Series 34 in native range is located 0.1 mile east of the northwest corner of Sec. 19, T2N, R84W. (Routt County)

A11 0-3"--Grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear smooth boundary.

A12 3-8"--Grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium subangular blocky structure; soft dry, very friable when moist, noncalcareous; clear smooth boundary.

A13 8-20"--Grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium presmatic structure parting to weak medium subangular blocks; soft when dry, very friable when moist; noncalcareous; very thin and patchy clay film; clear smooth boundary.

A14 20-30"--Grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse subangular blocky structure, noncalcareous; many decaying roots; clear smooth boundary.

Hesperus Series

A typical profile of Hesperus Series, in hayland, is located approximately 2,100 feet east and 528 feet north of the southwest corner of Sec. 34, T5N, R86W.

A11 0-3"--Grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine granular structure; soft dry and very friable when moist; pH 6.2; clear smooth boundary.

A12 3-8"--Dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft dry and very friable when moist; pH 6.8; clear smooth boundary.

B21t 8-20"--Dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate, medium prismatic structure parting to moderate, medium subangular blocks; pH of 7.0;

thick, nearly continuous clay films; clear smooth boundary.

B22t 20-44"--Dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; strong, medium prismatic structure parting to strong medium subangular blocks; pH 7.2; thick continuous clay films; clear smooth boundary.

B3 44-50"--Grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium subangular blocky structure; pH 7.2; about 15 percent of horizon has reddish brown (5YR 4/4) moist; mottles; gradual boundary.

IIc 50" plus--Grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; pH 7.3; about 75 percent of the horizon is gleyed with dark greenish gray (5GY 4/1) moist.

Soil Series Profile Descriptions of the Seneca 2-W Lease Area

See Appendix D - Soil Series Profile Descriptions of the Energy 1 and 2 Expansion Areas - for profile descriptions of the Bulkley, Delphill, Haybro, Hesperus, Hub, and Splitro Series.

Waterino Series

Surface layers (A1 horizons) are grayish-brown stratified silt loam, silty clay loam and clay loam, granular and subangular blocky structure and very friable, neutral, about 17 inches thick. Buried surface layer (A'1) is dark gray silt loam, subangular structure and very friable, neutral, about 7 inches thick. Buried upper subsoil (B'2 and B'2t) horizons are grayish-brown silty clay loam, prismatic structure with clay films and calcium carbonate, moderately alkaline, extends to over 60 inches.

Permeability is moderate and surface runoff medium; available water capacity is hig. Organic matter content is high.

Rock Outcrop

Rock Outcrop consists of exposures of bare rock; this land type is mapped in complex with the Delphill series. There is little or no soil material to support vegetative growth. Topsoil potential is poor.

TABLE VII-3

Soil Classification

Series	Family	Suborder	Order
Bulkley	Fine, montmorillonitic	Borollic Vertic Camborthids	Aridisols
Delphill	fine, loamy mixed calcareous, frigid	Ustic Torriorthents	Entisols
Haybro	fine, montomorillonitic	Borollic Vertic Camborthids	Aridisols
Hesperus	fine-loamy, mixed	Pachic Argiborolls	Mollisols
Hub	fine-loamy, mixed	Mollic Cryoboralfs	Alfisols
Splitro	loamy, mixed	Lithic Cryoborolls	Mollisols
Waterino	fine-silty, mixed	Pachic Argiborolls	Mollisols

ROUTT COUNTY, COLORADO

DATE RECEIVED October 25, 1974

DRILL HOLE: 30-C
DATE CORED: July 24, 1974
SECTION: NWNW 23
TOWNSHIP: 5N
RANGE: 88W

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF CACO$_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS	POTASSIUM	SALT	SODIUM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS CACO$_3$ EQUIV-ALENT	PPM	K+ PPM	HAZARD MMHO/CM	Na+ PPM
Surface Clay and Loam	0.0	R-4-664	1.5	0.03	6.9	0.94	2.02		1.08	5	246	0.5	9
Surface Sand	1.5	R-4-665	8.5	0.28	7.7	8.75	66.65		57.90	2	93	0.5	14
Surface Clay, Sandstone, Claystone and Siltstone	10.0	R-4-666	5.3	0.03	8.0	0.94	77.58		76.64	1	72	0.7	18
Sandstone and Siltstone	15.3	R-4-667	4.7	0.06	7.8	1.88	88.26		86.38	2	107	0.7	28
(Lost 16.0-17.0)													
Sandstone	20.0	R-4-668	10.0	0.05	7.9	1.56	92.30		90.74	1	46	0.8	18
Sandstone, Shale, Siltstone	30.0	R-4-669	10.0	0.34	7.6	10.63	63.47		52.84	1	107	1.6	23
Siltstone and Shale	40.0	R-4-670	5.3	0.29	7.6	9.06	63.23		54.17	1	155	1.5	38
Coal "Wadge Seam"	45.3	--	12.5	--	--	--	--		--	--	--	--	--
Shale, Sandstone, Siltstone	57.3	R-4-671	6.0	0.49	7.1	15.31	38.67		23.36	4	138	2.8	29

Total Depth 63.8'

DRILL HOLE: 42-C
DATE CORED: August 25, 1974
SECTION: NWNE 15
TOWNSHIP: 5N
RANGE: 88W

ROUTT COUNTY, COLORADO

DATE RECEIVED October 8, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF CACO$_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS	POTASSIUM	SALT	SODIUM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS CACO$_3$ EQUIV-ALENT	PPM	K+ PPM	HAZARD MMHO/CM	Na+ PPM
Surface Loam, Clay & Sand	0.0	R-4-611	6.0	0.24	7.1	7.50	18.97		11.47	14	227	0.7	283
Siltstone, Sandstone, Shale	6.0	R-4-612	12.8	0.21	6.0	6.56	19.71		13.15	17	72	4.9	96
Coal "Lennox Seam"	14.8	--	3.7	--	--	--	--		--	--	--	--	--
Shale, Sandstone, Siltstone	18.5	R-4-613	3.4	0.16	6.8	5.00	30.75		25.75	4	119	0.9	18
Coal	21.9	R-4-614	1.0	0.80	6.7	25.00	5.94	19.06		1	14	0.3	25
Shale, Siltstone, Sandstone	22.9	R-4-615	5.6	0.34	6.7	10.63	42.68		32.05	1	69	3.5	22
Sandstone, Siltstone, Shale	28.5	R-4-616	10.0	0.20	7.7	6.25	45.41		39.16	1	89	1.5	17
Siltstone and Sandstone	38.5	R-4-617	10.0	0.09	8.4	2.81	91.92		89.11	1	63	0.8	17
(Lost 42.1-43.1)													
Siltstone, Sandstone, Shale	48.5	R-4-618	10.0	0.29	7.8	9.06	45.55		36.49	2	93	1.6	22
(Lost 53.5-54.5)													
Shale	58.5	R-4-619	4.6	0.31	7.8	9.69	36.56		26.87	1	216	1.0	35
(Lost 59.3-59.9)													
Coal "Wadge Seam"	63.1	--	9.8	--	--	--	--		--	--	--	--	--
Shale and Sandstone	72.9	R-4-620	2.3	0.14	7.3	4.38	6.96		2.58	1	106	0.6	17
Coal "Wadge Seam"	75.2	--	2.1	--	--	--	--		--	--	--	--	--
Shale, Sandstone, Siltstone	77.3	R-4-621	6.0	0.36	7.5	9.56	38.34		28.78	2	97	1.6	13
Total Depth 83.3'													

ROUTT COUNTY, COLORADO

Seneca 2-W Mine, Chg. #12301-0830-99999
DRILL HOLE: 43-C
DATE CORED: August 28, 1974
SECTION: NWNE 15
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED December 2, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Surface Clay (Lost 9.8 - 10.0)	0.0	R-4-729	10.0	0.20	7.6	6.25	37.43		31.18	8	270	8.4	297
Surface Clay (Lost 14.7 - 15.4)	10.0	R-4-730	5.4	0.18	7.8	5.63	45.09		39.46	6	256	8.2	443
Clay (Lost 20.7 - 21.3, and 22.4 - 22.9)	15.4	R-4-731	7.5	0.39	7.7	12.19	33.73		21.54	3	237	14.0	353
Clay	22.9	R-4-732	7.1	0.53	7.6	16.56	44.31		27.75	3	265	13.0	237
Clay	30.0	R-4-733	10.0	0.56	7.7	17.50	46.51		29.01	2	249	14.0	192
Clay (Lost 48.9 - 49.2)	40.0	R-4-734	9.2	0.78	7.5	24.38	22.27	2.11		6	301	15.0	226
Shale	49.2	R-4-735	11.5	0.82	7.8	25.63	34.49		8.86	6	348	5.0	198
Siltstone	60.7	R-4-736	6.7	0.85	7.2	26.56	37.41		10.85	1	143	3.6	40
Coal "Lennox Seam"	67.4	—	3.4	—	—	—	—	—	—	—	—	—	—
Siltstone, Coal and Shale (Lost 76.8 - 77.8)	70.8	R-4-737	7.0	0.33	7.2	10.31	27.68		17.37	1	104	1.5	27
Sandstone, Siltstone, Shale	77.8	R-4-738	12.3	0.18	7.8	5.63	48.93		43.30	1	82	1.5	20
Sandstone	90.1	R-4-739	10.7	0.12	8.3	3.75	86.15		82.40	1	67	1.0	16
Sandstone, Siltstone, Shale	100.8	R-4-740	10.0	0.51	7.7	15.94	48.50		32.56	1	106	2.0	20
Siltstone and Shale (Lost 111.1 - 112.1)	110.8	R-4-741	4.6	0.30	8.0	9.38	40.19		30.81	1	199	0.8	37
Coal "Wadge Seam"	115.4	—	7.9	—	—	—	—		—	—	—	—	—
Siltstone, Sandstone, Coal	123.3	R-4-742	5.6	0.24	7.8	7.50	39.04		31.54	1	138	0.6	21
Total Depth 128.9'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 99-C
DATE CORED: August 6, 1974
SECTION: SWNW 22
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED October 8, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Surface Loam and Clay	0.0	R-4-600	10.0	0.03	7.5	0.94	45.07		44.13	21	392	0.8	46
Surface Loam and Clay	10.0	R-4-601	10.0	0.04	7.6	1.25	6.53		5.28	18	287	1.4	79
Sandstone	20.0	R-4-602	4.0	0.06	8.5	1.88	92.39		90.51	2	71	1.0	23
Siltstone, Coal & Shale	24.0	R-4-603	6.2	0.35	7.8	10.94	41.58		30.64	1	140	1.9	37
Sandstone, Siltstone & Shale	30.2	R-4-604	10.9	0.16	8.0	5.00	80.40		75.40	1	128	1.4	42
Coal "Wadge Seam"	41.1	--	11.9	--	--	--	--		--	--	--	--	--
Shale, Siltstone, Sandstone	53.0	R-4-605	5.0	0.20	7.7	6.25	37.59		31.34	1	97	0.9	41

Total Depth 58.0'

ROUTT COUNTY, COLORADO

DRILL HOLE: 125-C
DATE CORED: July 15, 1974
SECTION: NESW 23
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED October 25, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF CACO3 EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS CACO3 EQUIV-ALENT				
Surface Loam and Clay	0.0	R-4-672	4.0	0.07	6.4	2.19	8.59		6.40	14	661	0.5	9
Surface Clay and Sand	4.0	R-4-673	5.4	0.14	6.6	4.38	26.98		22.60	3	150	4.9	61
Sandstone and Shale (Lost 13.3-15.2)	9.4	R-4-674	10.8	0.08	7.8	2.50	70.18		67.68	3	55	0.9	18
Sandstone	20.2	R-4-675	11.2	0.14	8.2	4.38	92.14		87.76	1	54	1.4	14
Shale, Sandstone, Coal	31.4	R-4-676	4.8	0.29	7.4	9.06	57.43		48.37	1	93	1.8	18
Sandstone and Shale	36.2	R-4-677	12.1	0.17	7.9	5.31	87.40		82.09	1	106	1.5	23
Coal "Wadge Seam"	48.3	--	12.4	--	--	--	--		--	--	--	--	--
Shale, Siltstone, Sandstone	60.7	R-4-678	4.4	0.17	7.6	5.31	73.04		67.73	1	50	1.1	14
Total Depth 65.1'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 217-C
DATE CORED: June 27, 1974
SECTION: NWSW 26
TOWNSHIP: 5N
RANGE:" 88W

DATE RECEIVED October 17, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Surface Clay (Lost 3.0-3.5)	0.0	R-4-647	10.0	0.04	7.3	1.25	12.46		11.21	6	216	1.4	72
Surface Clay	10.0	R-4-648	8.8	0.55	7.7	17.19	38.19		21.00	4	235	14.5	155
Shale and Siltstone	18.8	R-4-649	11.2	2.16	7.6	67.50	35.28	32.22		1	363	13.5	92
Siltstone	30.0	R-4-650	10.0	0.99	7.4	30.94	35.86		4.92	1	283	6.0	57
Siltstone and Shale	40.0	R-4-651	5.4	0.75	7.1	23.44	29.59		6.15	1	118	3.8	23
Coal "Lennox Seam"	45.4	--	2.5	--	--	--	--	--	--	--	--	--	--
Shale, Sandstone, Siltstone	47.9	R-4-652	10.0	0.55	7.3	17.19	70.74		53.55	1	123	2.0	23
Siltstone and Sandstone	57.9	R-4-653	10.0	0.25	7.8	7.81	44.81		37.00	1	54	2.8	9
Sandstone and Shale	67.9	R-4-654	10.0	0.21	7.8	6.56	83.66		77.10	1	97	1.6	9
Sandstone, Siltstone, Shale	77.9	R-4-655	10.0	0.27	7.8	8.44	82.01		73.57	1	89	1.5	19
Shale, Siltstone, Sandstone	87.9	R-4-656	8.1	0.26	7.9	8.13	77.80		69.67	1	157	1.1	48
Coal "Wadge Seam"	96.0	--	12.4	--	--	--	--	--	--	--	--	--	--
Shale, Sandstone, Siltstone	108.4	R-4-657	5.4	0.42	6.7	13.13	43.06		29.93	4	97	2.3	37
Total Depth 113.8'													

Routt County, Colorado

Analysis by: Central Laboratory

Core No.: 217-C
Section: NWSW 26
Township: 5N
Range: 88W

MECHANICAL ANALYSIS

Depth (feet)	Primary Rock Type	Thickness (feet)	Lab No.	Particle Size Distribution			H_2O Holding Capacity % Moisture	
				% Sand	% Silt	% Clay	1/3 Bar	15 Bar
0.0	Surface Clay (Lost 3.0 - 3.5)	10.0	R-4-647	14.4	29.6	56.0	27.67	18.02
10.0	Surface Clay	8.8	R-4-648	12.4	25.6	62.0	27.87	21.34
18.8	Shale and Siltstone	11.2	R-4-649	12.4	27.6	60.0	27.15	18.29
30.0	Siltstone	10.0	R-4-650	34.4	13.6	48.0	15.36	8.83
40.0	Siltstone and Shale	5.4	R-4-651	31.6	34.4	34.0	9.77	4.79
45.4	Coal "Lennox Seam"	2.5	—	—	—	—	—	—
47.9	Shale, Sandstone, and Siltstone	10.0	R-4-652	33.6	40.4	26.0	14.01	6.05
57.9	Siltstone and Sandstone	10.0	R-4-653	43.6	42.4	14.0	9.22	3.15
67.9	Sandstone and Shale	10.0	R-4-654	33.6	42.4	24.0	13.00	5.35
77.9	Sandstone, Siltstone, and Shale	10.0	R-4-655	40.0	36.8	23.2	9.39	4.74
87.9	Shale, Siltstone and Sandstone	8.1	R-4-656	30.0	36.8	33.2	11.98	6.45
96.0	Coal "Wadge Seam"	12.4	—	—	—	—	—	—
108.4	Shale, Sandstone, and Siltstone	5.4	R-4-657	48.0	28.8	23.2	10.77	5.38
	Total Depth 113.8'							

Core # 217-C
Section: NWSW 26
Township: 5N
Range: 88W

Analysis by: Central Laboratory

CHEMICAL ANALYSIS

Depth (feet)	Primary Rock Type	Thickness (feet)	Lab No.	H_2O Soluble Cations				Sodium Adsorption Ratio	Cation Exchange Capacity meq/100g	NH_4CAC Extractable		Saturation %
				Ca meq/1	Mg meq/1	Na meq/1	K meq/1			Na ppm	K ppm	
0.0	Surface Clay (Lost 3.0 - 3.5)	10.0	R-4-647	5.34	3.25	1.75	0.22	0.85	20.3	72	216	60.50
10.0	Surface Clay	8.8	R-4-648	22.51	86.13	5.94	0.45	0.81	18.1	155	235	62.50
18.8	Shale and Siltstone	11.2	R-4-649	23.43	61.94	5.37	1.25	0.82	26.6	92	363	63.50
30.0	Siltstone	10.0	R-4-650	24.71	96.13	4.57	2.32	0.59	19.8	57	283	31.22
40.0	Siltstone and Shale	5.4	R-4-651	25.00	66.03	3.82	1.60	0.57	7.1	23	118	23.00
45.4	Coal "Lennox Seam"	2.5										
47.9	Shale, Sandstone, and Siltstone	10.0	R-4-652	24.08	27.38	1.86	1.00	0.37	7.9	23	123	27.20
57.9	Siltstone and Shale	10.0	R-4-653	23.84	29.03	0.94	0.81	0.18	3.7	9	54	27.50
67.9	Sandstone and Shale	10.0	R-4-654	15.28	25.56	1.34	0.90	0.30	5.4	9	97	22.50
77.9	Sandstone, Siltstone, and Shale	10.0	R-4-655	8.05	23.36	1.38	0.74	0.35	6.8	19	89	22.50
87.9	Shale, Siltstone, and Sandstone	8.1	R-4-656	7.93	8.90	3.94	0.62	1.36	7.1	48	157	26.50
96.0	Coal "Wadge Seam"	12.4										
108.4	Shale, Sandstone, and Siltstone	5.4	R-4-657	32.83	22.58	2.17	0.74	0.41	10.4	37	97	27.00
	Total Depth 113.8 ft.											

ROUTT COUNTY, COLORADO

DRILL HOLE: 286-C
DATE CORED: June 26, 1974
SECTION: NWNW 35
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED October 17, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Clay	0.0	R-4-633	6.6	0.14	7.6	4.38	44.32		39.94	3	284	6.4	221
(Lost 2.2-2.8, 3.6-3.8)													
Shale	6.6	R-4-634	9.0	0.16	7.8	5.00	44.15		39.15	2	201	6.3	196
Sandstone and Shale	15.6	R-4-635	4.4	0.35	7.7	10.94	71.66		60.72	1	212	13.0	102
Shale and Sandstone	20.0	R-4-636	10.0	0.83	6.6	25.94	10.55	15.39		19	315	17.0	72
(Lost 27.0-29.0)													
Shale, Claystone, Sandstone	30.0	R-4-637	10.0	0.97	7.3	30.31	37.32		7.01	1	294	7.9	40
Shale	40.0	R-4-638	3.6	0.61	7.3	19.06	36.33		17.27	1	142	3.4	25
Coal "Lennox Seam"	43.6	—	2.9	—	—	—	—		—	—	—	—	—
Shale and Sandstone	46.5	R-4-639	10.0	0.57	7.0	17.81	43.12		25.31	1	85	2.9	14
Sandstone and Siltstone	56.5	R-4-640	10.0	0.31	7.7	9.69	80.76		71.07	1	63	2.3	14
Sandstone, Siltstone, Shale	66.5	R-4-641	10.0	0.19	7.7	5.94	83.57		77.63	1	64	1.5	9
Sandstone	76.5	R-4-642	10.0	0.10	8.3	3.13	87.37		84.24	2	46	0.8	9
(Lost 83.5-83.8)													
Sandstone, Siltstone, Shale	86.5	R-4-643	9.7	0.25	7.8	7.81	40.96		33.15	1	119	1.9	14
Shale	96.2	R-4-644	2.7	0.25	7.8	7.81	46.71		38.90	1	162	1.4	14
Coal "Wadge Seam"	98.9	—	10.5	—	—	—	—		—	—	—	—	—
Shale and Sandstone	109.4	R-4-645	5.2	0.15	7.5	4.69	14.53		9.84	2	111	0.6	14
Coal "Wadge Seam"	114.6	—	2.5	—	—	—	—		—	—	—	—	—
Shale and Sandstone	117.1	R-4-646	5.0	0.16	7.5	5.00	42.59		37.59	1	123	1.8	14
(Lost 120.7-122.1)													
Total Depth 122.1'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 300-C
DATE CORED: July 28, 1974
SECTION: NENE 22
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED October 10, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Surface Loam and Clay	0.0	R-4-606	0.9	0.03	7.0	0.94	6.83		5.89	3	131	0.4	14
Sandstone	0.9	R-4-607	9.9	0.02	8.6	0.63	85.07		84.44	4	46	0.8	77
Siltstone,Sandstone, Shale (Lost 21.2-21.7)	10.8	R-4-608	10.9	0.05	8.2	1.56	45.76		44.20	8	76	0.9	74
Shale,Siltstone,Sandstone (Lost 23.5-23.8)	21.7	R-4-609	12.6	0.08	8.0	2.50	73.68		71.18	1	111	0.7	27
Coal "Wadge Seam"	34.3	--	12.9	--	--	--	--		--	--	--	--	--
Shale and Sandstone	47.2	R-4-610	6.0	0.22	7.4	6.88	41.13		34.25	1	93	1.8	27
Total Depth 53.2'													

ROUTT COUNTY, COLORADO

DATE RECEIVED October 8, 1974

DRILL HOLE: 311-C
DATE CORED: August 9, 1974
SECTION: SENW 22
TOWNSHIP: 5N
RANGE: 88W

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Surface Clay, Loam & Sand	0.0	R-4-592	3.6	0.11	6.4	3.44	10.83		7.39	1	224	0.3	33
Siltstone and Coal	3.6	R-4-593	7.0	0.17	7.4	5.31	45.64		40.33	6	107	7.8	186
Sandstone	10.6	R-4-594	9.6	0.10	7.7	3.13	46.11		42.98	1	54	2.1	36
Shale and Siltstone (Lost 20.2 - 20.7)	20.2	R-4-595	2.4	1.01	7.1	31.56	46.28		14.72	8	97	1.5	32
Sandstone	22.6	R-4-596	10.2	0.08	8.3	2.50	83.50		81.00	1	54	0.7	14
Siltstone, Shale, & Sandstone	32.8	R-4-597	8.1	0.18	7.9	5.63	81.89		76.26	1	89	1.1	23
Sandstone, Siltstone, & Shale (Lost 41.6-42.0, 44.1-44.6)	40.9	R-4-598	9.3	0.22	7.8	6.88	78.26		71.38	1	154	1.8	42
Coal "Wadge Seam"	50.2	--	11.9	--	--	--	--		--	--	--	--	--
Shale, Sandstone & Silt	62.1	R-4-599	5.0	0.24	7.5	7.50	34.52		27.02	1	128	1.1	42

Total Depth 67.1'

ROUTT COUNTY, COLORADO

DRILL HOLE: 508-C
DATE CORED: August 22, 1974
SECTION: NENE 15
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED December 2, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CACO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CACO_3$ EQUIV-ALENT				
Surface Clay and Sand	0.0	R-4-743	10.0	0.10	7.8	3.13	56.75		53.62	4	241	4.1	320
(Lost 9.5 - 10.0)													
Siltstone,Coal, and Shale	10.0	R-4-744	10.0	0.23	5.0	7.19	12.99		5.80	8	75	3.5	18
(Lost 15.6 - 17.1)													
Siltstone,Shale, Sandstone	20.0	R-4-745	10.0	0.33	5.6	10.31	30.61		20.30	8	71	1.4	13
(Lost 20.0 - 21.0)													
Sandstone,Siltstone,Shale	30.0	R-4-746	10.0	0.21	7.3	6.56	39.21		32.65	1	86	1.2	13
Sandstone	40.0	R-4-747	10.0	0.20	7.8	6.25	92.02		85.77	1	74	1.5	10
(Lost 43.0 - 43.6)													
Sandstone,Siltstone,Shale	50.0	R-4-748	10.0	0.33	7.3	10.31	82.66		72.35	5	141	1.7	16
Shale	60.0	R-4-749	2.4	0.32	7.1	10.00	18.61		8.61	2	200	1.0	32
Coal "Upper Wadge Seam"	62.4	--	9.4	--	--	--	--		--	--	--	--	--
Shale	71.8	R-4-750	1.9	0.24	7.2	7.50	7.83		0.33	2	246	0.9	16
Coal "Lower Wadge Seam"	73.7	--	2.2	--	--	--	--		--	--	--	--	--
Shale,Sandstone,Siltstone	75.9	R-4-751	4.6	0.56	6.9	17.50	40.96		23.46	2	110	2.3	8
Total Depth 80.5'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 555-C
DATE CORED: June 26, 1974
SECTION: SESE 15
TOWNSHIP: 5N
RANGE:" 88W

DATE RECEIVED October 25, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF CACO3 EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CACO_3$ EQUIV-ALENT				
Surface Loam and Clay	0.0	R-4-658	0.5	0.05	6.7	1.56	9.03		7.47	13	416	0.6	1
Sandstone and Claystone	0.5	R-4-659	9.5	0.03	7.6	0.94	39.14		38.20	3	50	0.6	5
Claystone and Sandstone	10.0	R-4-660	10.0	0.06	8.0	1.88	89.42		87.54	1	42	0.5	5
Siltstone, Sandstone, Shale	20.0	R-4-661	10.0	0.31	7.5	9.69	42.45		32.76	1	106	1.7	14
(Lost 21.0-21.4)													
Shale and Sandstone	30.0	R-4-662	10.2	0.21	7.7	6.56	76.64		70.08	1	85	1.0	14
Coal "Wadge Seam"	40.2	--	12.3	--	--	--	--		--	--	--	--	--
Shale, Sandstone, Siltstone	52.5	R-4-663	5.0	0.47	7.0	14.69	38.83		24.14	1	136	1.6	28
Total Depth 57.5'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 569-C
DATE CORED: August 12, 1974
SECTION: NWNE 22
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED December 2, 1974

						TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL							
LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT	PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
Surface Clay and Sand	0.0	R-4-710	8.9	0.06	6.8	1.88	16.32		14.44	8	201	0.8	18
Coal and Shale	8.9	R-4-711	2.6	0.54	3.8	16.88	- 28.29	45.17		3	58	0.3	216
(Lost 11.0 - 11.3)													
Siltstone	11.5	R-4-712	3.2	0.09	4.8	2.81	16.32		13.51	23	59	0.5	29
(Lost 14.0 - 14.5)													
Shale	14.7	R-4-713	1.8	0.29	6.1	9.06	9.70		0.64	2	105	0.7	43
Sandstone and Siltstone	16.5	R-4-714	4.6	0.26	7.3	8.13	87.47		79.34	2	154	1.9	24
Sandstone and Siltstone	21.1	R-4-715	8.9	0.10	7.5	3.13	42.78		39.65	1	55	2.4	16
Shale,Siltstone,Sandstone	31.0	R-4-716	9.0	0.13	7.9	4.06	95.36		91.30	1	94	1.5	24
Sandstone,Shale,Siltstone	40.0	R-4-717	10.0	0.22	7.8	6.88	79.59		72.71	2	98	1.2	18
Siltstone,Sandstone,Shale	50.0	R-4-718	10.0	0.20	7.8	6.25	87.16		80.91	1	138	1.0	21
(Lost 59.2 - 60.0)													
Shale	60.0	R-4-719	2.6	0.34	7.0	10.63	13.52		2.89	2	198	0.5	59
(Lost 60.0 - 60.2)													
Coal "Wadge Seam"	62.6	--	10.7	--	--	--	--		--	--	--	--	--
Siltstone and Sandstone	73.3	R-4-720	5.0	0.21	7.4	6.56	39.07		32.51	1	98	0.9	34
Total Depth 78.3'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 609-C
DATE CORED: August 20, 1974
SECTION: SENE 15
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED December 2, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CaCO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOS-PHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CaCO_3$ EQUIV-ALENT				
Surface Loam and Clay	0.0	R-4-721	2.0	0.05	6.9	1.56	9.49		7.93	12	434	0.5	7
Surface Clay and Sand	2.0	R-4-722	3.9	0.03	7.8	0.94	42.47		41.53	2	129	0.6	9
Sandstone	5.9	R-4-723	4.1	0.03	8.4	0.94	48.77		47.83	3	43	0.3	4
(Lost 6.6 - 7.6)													
Sandstone and Siltstone	10.0	R-4-724	10.0	0.03	8.3	0.94	49.20		48.26	2	50	0.3	9
Sandstone	20.0	R-4-725	10.0	0.23	8.1	7.19	92.79		85.60	1	58	1.4	7
Sandstone, Shale, Siltstone	30.0	R-4-726	10.0	0.26	7.6	8.13	46.49		38.36	3	85	1.6	11
Sandstone and Shale	40.0	R-4-727	5.1	0.21	7.8	6.56	45.61		39.05	2	109	1.0	18
(Lost 43.4-43.6, 44.9-45.1)													
Coal "Wadge Seam"	45.1	--	12.0	--	--	--	--		--	--	--	--	--
Sandstone and Coal	57.1	R-4-728	6.0	0.79	4.1	24.69	0.85	23.84		24	38	2.5	16
Total Depth 63.1'													

ROUTT COUNTY, COLORADO

DRILL HOLE: 711-C
DATE CORED: July 6, 1974
SECTION: NENW 35
TOWNSHIP: 5N
RANGE: 88W

DATE RECEIVED October 17, 1974

LITHOLOGY	DEPTH	LAB NO.	THICKNESS	% DRY SULFUR	pH	TONS OF $CACO_3$ EQUIVALENT PER 1000 TONS MATERIAL				PHOSPHORUS PPM	POTASSIUM K+ PPM	SALT HAZARD MMHO/CM	SODIUM Na+ PPM
						MAX. REQU. FROM TOTAL SULFUR	AMT. PRES. TITRATION	AMT. NEEDED FOR NEUTRALITY	EXCESS $CACO_3$ EQUIV-ALENT				
Surface Loam and Clay	0.0	R-4-622	2.0	0.07	6.6	2.19	18.43		16.24	19	337	0.4	9
Sandstone	2.0	R-4-623	9.0	0.03	7.0	0.94	3.77		2.83	1	29	0.2	13
(Lost 6.0-6.3, 7.8-8.3)													
Sandstone	11.0	R-4-624	11.0	0.03	7.8	0.94	15.21		14.27	2	29	0.3	9
Sandstone	22.0	R-4-625	12.0	0.06	8.2	1.88	89.45		87.57	2	34	0.4	18
(Lost 22.0-24.0)													
Coal, Shale, and Sandstone	34.0	R-4-626	12.0	0.04	8.2	1.25	88.24		86.99	2	25	0.6	17
(Lost 34.0-34.2)													
Sandstone and Siltstone	46.0	R-4-627	14.0	0.25	7.5	7.81	36.75		28.94	1	54	2.3	13
Siltstone and Shale	60.0	R-4-628	10.0	1.19	7.0	37.19	22.92	14.27		2	171	3.2	17
Siltstone, Shale, Sandstone	70.0	R-4-629	10.0	1.08	6.8	33.75	16.40	17.35		3	121	3.5	17
Coal, Shale, Siltstone and Sandstone	80.0	R-4-630	10.9	0.18	7.6	5.63	46.39		40.76	2	76	1.5	17
Coal "Wolf Creek Seam"	90.9	--	7.4	--	--	--	--		--	--	--	--	--
Coal, Shale, Sandstone & Siltstone	98.3	R-4-631	2.7	0.29	7.0	9.06	25.45		16.39	2	132	1.3	17
Coal "Wolf Creek Seam"	101.0	--	15.8	--	--	--	--		--	--	--	--	--
Sandstone and Shale	116.8	R-4-632	6.0	0.20	6.5	6.25	3.89	2.36		1	81	1.7	17
Total Depth 122.8'													

Seneca 2-W

Routt County, Colorado

Analysis by: Central Laboratory

Chemical and Mechanical Analysis
on
Whole Overburden Core

Core Number	Section	Township	Range	Date Cored	Lab No.	1:1 pH	% Dry Sulfur	Tons of $CaCO_3$ Equiv. per 1000 Tons of Material				Phos-phorous ppm	Salt Hazzard mmho/cm	NH_4OAc Extractant	
								Maximum Requirement from Total Sulfur	Amount Present (Titration)	Amount Needed for Neutrality	Excess $CaCO_3$ Equivalent			K ppm	Na ppm
30-C	NWNW 23	5N	88W	7-24-74	R-4-699	7.9	0.15	4.69	48.98		44.29	1	0.64	94	23
711-C	NENW 35	5N	88W	7-06-74	R-4-700	7.2	0.33	10.31	44.43		34.12	2	1.45	85	14
555-C	SESE 15	5N	88W	6-26-74	R-4-701	7.8	0.16	5.00	44.58		39.58	1	0.64	77	14
217-C	NWSW 26	5N	88W	6-27-74	R-4-702	7.4	0.45	14.06	46.10		32.04	1	5.05	164	56

Core Number	Lab No.	Ca meq/1	Water Soluble Cations		K meq/1	Sodium Adsorption Ratio	Saturation %	Cation Exchange Capacity meq/100g	Particle Size Distribution			Water Holding Capacity % Moisture	
			Mg meq/1	Na meq/1					% Sand	% Silt	% Clay	1/3 Bar	15 Bar
30-C	R-4-699	3.81	4.53	0.44	0.20	0.22	38.00	10.2	36.0	34.8	29.2	13.58	7.13
711-C	R-4-700	20.37	11.92	0.74	0.68	0.36	32.50	9.0	40.8	36.0	23.2	10.63	5.23
555-C	R-4-701	7.06	6.07	0.56	0.29	0.27	33.00	7.3	44.8	32.8	23.2	12.49	5.71
217-C	R-4-702	24.40	48.29	3.86	0.79	1.89	37.50	15.3	32.8	28.0	39.2	16.22	9.11

Terrestrial Fauna

APPENDIX D

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FOR
TERRESTRIAL FAUNA

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Figure	Title	Page
VIII-1	Big Game Management Units------------------------------------	VIII-36

Terrestrial Fauna

TABLE VIII-1
Species Known or Believed to Inhabit the Impact Region

Legend

1) SPECIES STATUS
   ** On federal threatened species list
   * On Colorado endangered species list
   X On Audubon Society "Blue list"

2) SEASON OF USE
   First Column
   Y - Yearlong
   M - Fall and Spring migration
   S - Summer
   W - Winter
   U - Undetermined
   Second Column
   C - Common
   UC - Uncommon
   R - Rare
   U - Undetermined

3) REGIONAL OCCURRENCE
   E - Energy Fuels
   G - W. R. Grace
   P - Peabody
   W - Western Mines
   R - W. R. Grace Railroad

4) HABITAT TYPES*

Vegetation
1 - Grasslands
4 - Sagebrush
5 - Mountain shrub (oak, serviceberry, etc)
6 - Conifer (except pinyon-juniper)
7 - Barren (rocky, boulder strewn intermixed with grass and shrubs)
9 - Pinyon - Juniper
10a - Aspen
13 - Greasewood
14 - Saltbush
19 - Croplands
20 - Riparian

Aquatic
1 - Seasonally flooded basins or flats
2 - Rivers and streams
3 - Shallow fresh marsh (as much as six inches of water)
4 - Deep fresh marsh (six inches to three feet of water)
5 - Open fresh water (over three feet of water)

* Habitat used X
Preferred or critical habitat #

SPECIES 1/ WILD FAUNA	SEASON OF USE 2/		REGIONAL OCCURRENCE 3/	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
MAMMALS																				
Masked shrew (Sorex cinereus)	Y	U	E				X							#	#		X			Vary greatly from year to year
Vagrant shrew (Sorex vagrans)	Y	C	E G P			X	X			X				#	#		X			
Water shrew (Sorex palustris)	Y	U					X		X					X	X	X	X			
Merriam's shrew (Sorex merriami)	Y	UC	E P	X	X	X			X											
Little brown bat (Myotis lucifugus)	M-S	U	E			X	#		X	X				#						
Long-eared Myotis (Myotis evotis)	M-S	U	E				X		X		X	#		#						
Long-legged Myotis (Myotis volans)	M-S	U	E			#	X		X	X				#						
Small-footed Myotis (Myotis leibii)	Y	U	E	X		X								X	X		X			
Silver-haired bat (Lasionycteris noctivagans)	M-S	U	E				X		X	X				#						
Big Brown bat (Eptesicus fuscus)	Y	U	E			X	X		X	X				X						

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Hoary Bat (Lasiurus cinereus)	M-S	UC	E				X		X	X				X						
Western big-eared bat (Plecotus townsendii)	Y	U	E			#	X		X											
Pallid bat (Antrozous pallidus)	M-S	U	E					#	X		X	X								
Nuttall's cottontail (Sylvilagus nuttallii)	Y	C	E P W		X	X	#		#	#			X	#						Population numbers variable with year for all lagomorphs listed below
Desert cottontail (Sylvilagus audubonii)	Y	UC	E G W	X	X	#					#	#								
Snowshoe hare (Lepus americanus)	Y	C	E P W				X			#										
Black-tailed jackrabbit (Lepus californicus)	U	U	G	X		X			X		#	#	#							
White-tailed jackrabbit (Lepus townsendii)	Y	C	E G P W	X	#	X	X		X	X	#	#	#	X						
Cliff chipmunk (Eutamias dorsalis)	Y	UC				X		#	X											Only in northwestern portion of region
Least chipmunk (Eutamias minimus)	Y	UC	E G P		X	X	X		X	X	X	X		X						

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Colorado chipmunk (Eutamias quadrivittatus)	Y	U	G W R			X	X	#	X											Only in western portion of region
Unita chipmunk (Eutamias umbrinus)	Y	U	E				#													
Yellow-bellied marmot (Marmota flaviventris)	Y	C	E G P W R			X	X	#		X				X						
White-tailed antelope squirrel (Ammospermophilus leucurus)	Y	R	R			X			X		X	X								
Richardson's ground squirrel (Spermophilus richardsonii)	Y	C	E G P W R	#	#															
Thirteen-lined ground squirrel (Spermophilus tridecemlineatus)	Y	C	E P R	#	X	X			X											
Golden-mantled ground squirrel (Spermophilus lateralis)	Y	C	E G P W		X	X	#	X	#	#				X						
Rock squirrel (Spermophilus variegatus)	U	U	R			X		#	X											

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
White-tailed prairie dog (*Cynomys leucurus*)	Y	C	E R	#	X						X	X								
Red squirrel (*Tamiasciurus hudsonicus*)	Y	C	E P				#		X											
Northern pocket gopher (*Thomomys talpoides*)	Y	C	E P W	X	X	X	X		X	X			X	X						
Olive-backed pocket mouse (*Perognathus fasciatus*)	Y	UC		X		X														Only in north-western portion of region
Ord's kangaroo rat (*Dipodomys ordii*)	Y	C	E	X	X						#	#								Sandy soils on central portion of region
Beaver (*Castor canadensis*)	Y	C	E G P R											#		#	X	#		
Western harvest mouse (*Reithrodontomys megalotis*)	Y	UC		X										#	#					Only in western portion of region
Canyon mouse (*Peromyscus crinitus*)	Y	U				X		#	X											
Deer mouse (*Peromyscus maniculatus*)	Y	C	E G P W R	X	X	X	X	X	X	X	X	X	X	X						Most numerous mammal in region
Pinon mouse (*Peromyscus truei*)	Y	C	E					X	#											

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE					HABITAT TYPES 4/																REMARKS
								VEGETATION											AQUATIC					
								1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Northern grasshopper mouse (Onychomys leucogaster)	Y	C						#	X						X	X								
Bushy-tailed woodrat (Neotoma cinerea)	Y	C	E		P				X	X	X	#	X											
Gapper's redbacked vole (Clethrionomys gappari)	U	U	E		P						#		X											
Montane vole (Microtus montanus)	Y	C	E	G	P	W					X			X										Open meadows
Long-tailed vole (Microtus longicaudus)	Y	U	E		P	W			X		X			X				#	#					
Sagebrush vole (Lagurus curtatus)	Y	UC	E		P	W		X	#															
Muskrat (Ondatra zibethicus)	Y	C	E	G	P		R											X		#	X	X	X	
House mouse (Mus musculus)	Y	C						X	X															
Western jumping mouse (Zapus princeps)	Y	C	E	G	P						X			X				#						Willow bottoms
Porcupine (Erethizon dorsatum)	Y	C	E	G	P	W	R		X	X	#	X	X	X	X	X		#						

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE					HABITAT TYPES 4/																REMARKS
								VEGETATION											AQUATIC					
								1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Coyote (Canis latrans)	Y	C	E	G	P	W	R	X	X	X	X	X	X	X	X	X	X	X	X		X	X		
Red fox (Vulpes fulva)	Y	C	E		P	W			X	X	X						X	#	X		X			
Gray fox (Urocyon cinereoargenteus)	Y	C		G			R			#			X		X	X								
Ringtail (Bassariscus astutus)	Y	R								X			X					#						
Raccoon (Procyon lotor)	Y	C	E	G	P	W	R											#	X	X	X	X		
Black bear (Ursus americanus)	Y	C	E		P	W	R			X	#		X	X				X						
Black-footed ferret ** (Mustela nigripes) *	Y	R	E					#	X						X	X								
Short-tailed weasel (Mustela erminea)	Y	U	E	G	P		R				X			X										
Mink (Mustela vison)	Y	R	E		P		R											#		X				
Long-tailed weasel (Mustela frenata)	Y	C	E	G	P	W	R	X	X	X	X	X	X	X	X	X	X	X						

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE					HABITAT TYPES 4/																REMARKS
								VEGETATION											AQUATIC					
								1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Badger (Taxidea taxus)	Y	C	E		P	W		X	X	X	X		X	X	X	X	X	X						
Spotted skunk (Spilogale putorius)	Y	UC	E	G			R			X			X		X	X	X	#	X					
Striped skunk (Mephitis mephitis)	Y	C	E	G	P	W	R	X	X	X	X	X	X	X	X	X	X	#	X					
River otter (Lutra canadensis) *	Y	U	E															X		#				
Cougar (Felis concolor)	Y	C	E			W	R			X	#	#	X	X				X						
Bobcat (Lynx rufus)	Y	C	E	G	P	W	R		X	X	X		X	X	X	X	X	#	X					
Elk (Cervus canadensis)	Y	C	E	G	P	W	R	X	X	#	X			#		X	#	X	X					
Moose (Alces alces)	U	R																						Only known as wandering individuals
Mule deer (Odocoileus hemionus)	Y	C	E	G	P	W	R	X	X	#	X		X	X	X	X	X	X	X					
White-tailed deer (Odocoileus virginianus)	U	U	E		P																			Few recorded sightings

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Pronghorn (Antilocapra americana)	Y	C	R	#	#						X	X								
Bighorn sheep (Ovis candensis)	Y	R				#			X	X										

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S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/ VEGETATION											HABITAT TYPES 4/ AQUATIC					REMARKS
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
BIRDS																				
Common loon (Gavia immer)	M	R	E R															X	#	
Eared grebe (Podiceps nigricollis)	M	C	E P R															X	#	Possible nester
Horned grebe (Podiceps auritus)	M	U	R												X		X	X	X	Probable in region
Western grebe (Aechmophorus occidentalis)X	M	R	E P R												X		X	#	X	Possible nester
Pied-billed grebe (Podilymbus podiceps)	M	UC	E R												X	X	X	X	X	
Great blue heron (Ardea herodias)	S	C	E G P R											X	X	#	#	X		
Little blue heron (Florida caerulea)	S	U														#				Possible resident
Snowy egret (Egretta thula)	S	C	E R												X	X	X	X		
Black-crowned night heron X (Nycticorax nycticorax)	S	UC	E R													X	X	X		
White faced ibis (Plegadis chihi) X	M	R	E R												X		X	X		

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Whistling swan (Olor columbianus)	M	UC	E			R													X			X	
Canada goose (Branta canadensis)	M-S	C	E	G	P	R										X	X	X	X	X	X	X	Known nester
White-fronted goose (Aser albifrons)	M	R	E			R										X	X	X	X	X	X	X	
Snow goose (Chen caerulescens)	M	R	E			R										X	X	X	X	X	X	X	
Mallard (Anas platyrhynchos)	Y	C	E	G	P	R										X	X	X	X	X	X	X	Known nester
Gadwall (Anas strepera)	M	C	E	G		R										X	X	X	X	X	X	X	
Pintail (Anas acuta)	M-S	C	E	G	P	R										X	X	X	X	X	X	X	Known nester
Cinnamon teal (Anas cyanoptera)	M-S	C	E	G	P	R											X	X	X	X	X		Known nester
Green-winged teal (Anas crecca)	M-S	C	E	G	P	R											X	X	X	X	X	X	Known nester
Blue-winged teal (Anas discors)	M-S	C	E	G	P	R											X	X	X	X	X		Known nester

SPECIES [1/] WILD FAUNA	SEASON [2/] OF USE		REGIONAL OCCURRENCE [3/]		HABITAT TYPES [4/]																REMARKS
					VEGETATION											AQUATIC					
					1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
American widgeon (Mareca americana)	M	C	E G	R										X	X	X	X	X	X	X	Known nester
Shoveller (Anas clypeata)	M	C	E	R										X	X	X	X	X	X	X	
Redhead (Aythya americana)	M	UC	E G P	R													X		X	X	Known nester
Ring-neck duck (Aythya collaris)	M	UC	E	R													X		X	X	
Canvasback (Aythya valisineria)	M	UC	E G	R													X		X	X	
Greater scaup (Aythya marila)	M	R	G	R													X		X	X	
Lesser scaup (Aythya affinis)	M	C	E G P	R													X		X	X	
Common goldeneye (Bucephala clangula)	M-W	C	E	R													X		X	X	
Barrows goldeneye (Bucephala islandica)	W	R		R													X	X	X	X	
Bufflehead (Bucephala albeola)	M	UC	E	R													X	X	X	X	

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Ruddy duck (Oxyura jamaicensis)	M-S	C	E G R												X	X	X	X	X	
Hooded merganser (Lophodytes cucullatus)	W	U	E G R													X		X	X	Probable in region
Common merganser (Mergus merganser)	W	C	E G P R													X	X	X	X	
Red-breasted merganser (Mergus serrator)	W	UC	R													X		X	X	
Turkey vulture (Cathartes aura)	S	C	E G P W R	X	X	X	X	X	X	X	X	X	X	#						Known nester
Goshawk (Accipter gentilis)	W-S	R	E P R				#		X											Known nester
Sharp-shinned hawk (Accipter striatus)^{X}	W-S	C	E P R				#		X					X						
Cooper's hawk (Accipter cooperii)^{X}	W-S	C	E G P R			X	X		X	X				#						Known nester
Swainson's hawk (Buteo swainsoni)^{X}	M-S	C	E P R	X	X	X	X	X	X	X	X	X	X	X	X					Probable nester
Rough-legged hawk (Buteo lagopus)	W	C	E P R	#	X	X		X			X	X	X	X	X		X			

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE	REGIONAL OCCURRENCE 3/						HABITAT TYPES 4/																REMARKS
								VEGETATION											AQUATIC					
								1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Red-tailed hawk (Buteo jamaicensis)	Y	C	E	G	P	W	R	X	X	X	X	X	X	X	X	X	X	X	X					Known nester
Ferruginous hawk (Buteo regalis) X	W	UC	E		P		R	#	X	X		X			X	X	X	X	X					Historically a nester
Golden eagle (Aquila chrysaetos)	Y	C	E	G	P	W	R	X	X	X	X	X	X	X	X	X	X	X	X					Known nester
Bald eagle (Haliaectus leucocephalus)	W	UC	E	G	P	W	R	X	X						X	X		#		X	X	X	X	
Marsh hawk (Circus cyaneus) X	W-S	UC	E	G	P		R	#	X	X		X		X	X	X	X	X	#		#			
Prairie falcon (Falco mexicanus) X	Y	R	E	G	P		R	#	X	X		X			X	X	X	X	X					
Pigeon hawk (Falco columbarius)	W	R	E		P		R			X	X		X	X			X	X						
American kestrel (Falco sparverius) X	S	C	E	G	P	W	R	#	X	X		X		X	X	X	#	#	X					Known nester
Peregrine falcon ** (Falco peregrinus) *	M	R	E	G			R	#	X	X		X			X	X	X	#	X		X	X	X	
Blue grouse (Dendragapus obscurus)	Y	C	E	G	P		R				#		X	#				X						Known nester

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL OCCURRENCE 3/				HABITAT TYPES 4/ VEGETATION											AQUATIC					REMARKS
							1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Ruffed grouse (Bonasa umbellus)	U	R											#										Reported north of Din. Nat. Monument
Sharp-tailed grouse (Pedioecetes phasianellus)	Y	C	E		P	R	#		X							#	X	X					Known nesters
Sage grouse (Centrocercus urophasianus)X	Y	C	E	G	P	R		#															Known nester
Ring-necked pheasant (Phasianus colchicus)	Y	UC														#	X						Known nester
Chukar (Alectoris chukar)	U	U		G		R	X				#												Birds not responding well in most release sites
Gray partridge (Perdix perdix)	U	U														#							Birds released but no population information
Greater sandhill crane (Grus canadensis tabida)'*	S	UC				R	X									#	#	X	X		X		Known nesters
Virginia rail (Rallus limicola)	S	U	E			R														X	X		
Sora (Porzana carolina)	S	UC	E		P	R														X	X		
American coot (Fulica americana)	M-S	UC		G		R													X	X	X		

SPECIES[1/] WILD FAUNA	SEASON[2/] OF USE		REGIONAL OCCURRENCE[3/]				HABITAT TYPES[4/]																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Semipalmated plover (Charadrius semipalmatus)	M	U				R													X	X			Possible in region
Killdeer (Charadrius vociferus)	M-S	C	E	G	P	R										X		X	X	X			
Common snipe (Capella gallinago)	M-S	C	E	G	P	R	X									X	X	#	X	#			
Long-billed curlew (Numenius americanus)	M-S	U	E				X									X	X	X	X	X			Possible in region
Spotted sandpiper (Actitis macularia)	S	C	E		P	R											X		X	X			
Solitary sandpiper (Tringa solitaria)	M	C	E	G		R											X		X	X	X		
Greater yellowlegs (Totanus melanoleucus)	M	C	E			R													X	#	X		
Lesser yellowlegs (Totanus flavipes)	M	UC	E			R													X	#	X		
Baird's sandpiper (Calidris bairdii)	M	U				R											X	X	X	X			Probably fairly common
Least sandpiper (Calidris minutilla)	M	C	E			R											X	X	X	X			

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL OCCURRENCE 3/				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Willet (Catoptrophorus semipalmatus)	M	UC	E			R												X	X	X			May nest
Long-bill dowitcher (Limnodromus scolopaceus)	M	U	E		P	R												X	X	X			
Western sandpiper (Calidris mauri)	M	UC	E			R												X	X	X			
American avocet (Recurvirostra americana)	M	U	E			R												X	X	#	X		
Black-necked stilt (Himantopus mexicanus)	U	U				R												X	X	#	X		
Wilson's phalarope (Steganopus tricolor)	M	C	E	G	P	R												X	X	X	#	X	
Northern phalarope (Lobipes lobatus)	M	UC				R												X	X	X	#	X	
Herring gull (Larus argentatus)	M	UC	E			R										X	X		X	X	X	#	
California gull (Larus californicus)	M	R			P	R										X	X		X	X	X	#	
Ring-billed gull (Larus delawarensis)	M	UC	E		P	R										X	X		X	X	X	#	
Forster's tern (Sterna forsteri)	M	U	E			R													X	X	X	#	

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/ VEGETATION 1	4	5	6	7	9	10a	13	14	19	20	AQUATIC 1	2	3	4	5	REMARKS
Black tern (Chlidonias niger)	M	U	E R												X	X	X	#	#	
Band-tailed pigeon (Columba fasciata)	M-S	UC	E R				#													Higher mountainous elevations
Rock dove (Columba livia)	U	U	E G R			X	X	X	X	X			X	X						In and around areas of human habitation
Mourning dove (Zenaida macroura)	M-S	C	E G P W R	X		X			X	X		X	X	X						
Yellow-billed cuckoo (Coccyzus americanus)	M-S	U	E R				X		X					#						
Screech owl (Otus asio)	U	UC	E P R				X			X			#	#						
Barn owl (Tyto alba)X	U	U	E										#	#						
Great horned owl (Bubo virginianus)	Y	C	E P W R			X	X		X	X			X	#						Known nesters
Burrowing owl (Speotyto cunicularia)X	S	C	E R	#	X			X			X	X								Known nesters Associated with prairie dog towns.
Long-eared owl (asio otus)	Y	U	E R				X		X	X				#						

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL OCCURRENCE 3/				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Short-eared owl (Asio flammeus)	W	UC	E			R	#									X	X	X		#			
Saw-whet owl (Aegolius acadicus)	Y	UC	E		P	R				#		X					X						
Poor-will (Phalaenoptilus nuttallii)	S	C	E		P		X	X	X			X		X	X	X	X						
Common nighthawk (Chordeiles minor) X	S	C	E	G	P	R	#	X	X					X	X	X	X						Known nester
White-throated swift (Aeronautes saxatalis)	S	C	E	G	P	R					#												Known nester on sheer cliffs
Black-chinned hummingbird (Archilochus alexandri)	S	UC	E	G		R				X		X					#						
Broad-tailed hummingbird (Selasphorus platycercus)	S	C	E		P	R			X	X		X	X				#						High mountain meadows
Rufous hummingbird (Selasphorus rufus)	S	C	E	G		R				X							#						
Belted kingfisher (Megaceryle alcyon)	S	UC	E	G	P	R											X		X		X		
Common flicker (Colaptes auratus)	Y	C	E	G	P	R			X	X		X	X				#						

SPECIES[1/] WILD FAUNA	SEASON[2/] OF USE		REGIONAL[3/] OCCURRENCE				HABITAT TYPES[4/]																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Lewis' woodpecker (Asynodesmus lewis)X	Y	UC	E		P	R				#		X	X				#						
Redheaded woodpecker (Melanerpes erythrocephalus)	U	R	E														#						
Yellow-bellied sapsucker (Sphyrapicus varius)	S	C	E		P	R							#										
Williamson's sapsucker (Sphyrapicus thyroideus)	S	C	E			R				#		X											
Hairy woodpecker (Dendrocopos villosus) X	Y	UC	E		P	R				#		X	X				#						
Downy woodpecker (Dendrocopos pubescens)	Y	UC	E		P	R				X		X	X				#						
Eastern kingbird (Tyrannus tyrannus)	S	C	E			R										#	#	X	X	X			
Western kingbird (Tyrannus verticalis)	S	C	E	G	P	R	X								X	#	#	X	X	X			
Cassin's kingbird (Tyrannus vociferans)	S	UC				R			#	X							X						
Ash-throated flycatcher (Myiarchus cinerascens)	S	C	E	G		R			X			X			X	X							

SPECIES[1/] WILD FAUNA	SEASON[2/] OF USE		REGIONAL OCCURRENCE[3/]	HABITAT TYPES[4/] VEGETATION 1	4	5	6	7	9	10a	13	14	19	20	AQUATIC 1	2	3	4	5	REMARKS
Say's phoebe (*Sayornis saya*)	S	C	G P R	X	X	X		X	X		X	X	X	X						Commonly associated with Bluffs
Willow flycatcher (*Empidonax traillii*)	S	UC	E P R											#	X	X	X			Most often in willow bottoms
Hammond's flycatcher (*Empidonax hammondii*)	M-S	UC	P R						#											
Dusky flycatcher (*Empidonax oberholseri*)	S	U	E P R			X	X		X	X				X						
Gray flycatcher (*Empidonax wrightii*)	S	U	E R		X	X			X											
Western flycatcher (*Empidonax difficilis*)	S	C	E G P R				#							X						
Western wood peewee (*Contopus sordidulus*)	S	C	E G P R				#		X	X				#						
Horned lark (*Eremophila alpestris*)	Y	C	E G P R	#	X			X			X	X	X							
Violet-green swallow (*Tachycineta thalassina*)	S	C	E G P R	X	X	X	X		X					X	X	X	X	X		
Tree swallow (*Iridoprocne bicolor*)	M-S	C	E P R	X	X	X								X	X	X	X	X		

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Bank swallow (Riparia riparia)	M-S	UC	E R	X										#	X	X	X			
Rough-winged swallow (Stelgidopteryx ruficollis)	M-S	UC	E P R											#	X	X	X	X		
Barn swallow (Hirundo rustica)	M-S	C	E G P R	X									#	#	X	X				Often associated with human habitation
Cliff swallow (Petrochelidon pyrrhonota)	S	C	E G P R	X			X	#	X	X				#	X	X	X	X		Nests on rocky cliffs
Steller's jay (Cyanocitta stelleri)	Y	C	E G P W R			X	#		X	X				X						
Scrub jay (Aphelocoma coerulescens)	Y	C	E G P R		X	X			#					X						
Pinyon jay (Gymnothinus cyanocephalus)	Y	C	G R						#											
Black-billed magpie (Pica pica)	Y	C	E G P W R		X	X			X		X	X	X	X						
Clark's nutcracker (Nucifraga columbiana)	Y	C	E G R				#													
Common raven (Corvus corax)	Y	C	E P R		X	X	X				X	X	#	#						

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Common crow (Corvus brachyrhynchos)	Y	UC	E P W							X			#	X						
Black-capped chickadee (Parus atricapillus)	Y	UC	E P R			X	X		#	X				#						Known nester in pinyon
Mountain chickadee (Parus gambeli)	Y	C	E G P R			X	#		X	X										
Plain titmouse (Parus inornatus)	Y	UC	E R			X	X		X	X				X						
Bushtit (Psaltriparus minimus)	Y	UC	E R			X			X	X				X						
White-breasted nuthatch (Sitta carolinensis)	Y	UC	E R				X							#						
Grown creeper (Certhia familiaris)	Y	UC	E R				#													
Dipper (Cinclus mexicanus)	Y	C	E R													#				
House wren (Troglodytes aedon)	S	C	E P R			X	X		X					X						
Bewick's wren (Thryomanes bewickii) X	S	UC	E R			X			#											Known nester

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Canyon wren (Salpinctes mexicanus)	S	UC	E		P	R	X	X	#		#												
Rock wren (Salpinctes obsoletus)	S	C	E	G	P	R	X	X			#			X	X								Known nester
Catbird (Dumetella carolinensis)	U	U	E		P	R			#														
Sage thrasher (Oceoscoptes montanus)	S	C	E	G	P	R		X	#					X	X								
Robin (Turdus migratorius)	M-S	C	E	G	P	R		X	X			X	X	X	X	X	X	X		X			
Townsend's solitaire (Myadestes townsendi)	Y	UC	E			R				X		X	X				X						
Hermit thrush (Catharus guttatus)	S	C	E		P	R				X		X	X										
Swainson's thrush (Catharus ustulatus)	M	UC	E			R				X			X				#						
Veery (Catharus fuscescens)	S	UC	E			R							X				#						
Mountain bluebird (Sialia currucoides) X	M	C	E	G	P	R			X	X	X	X	X				X						Known nester

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE			HABITAT TYPES 4/																REMARKS
						VEGETATION											AQUATIC					
						1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Blue-gray gnatcatcher (*Polioptila caerulea*)	S	C	E	P	R		X	X			X					#						
Ruby-crowned kinglet (*Regulus calendula*)	M-S	C	E	P	R				X		X											
Bohemian waxwing (*Bombycilla garrulus*)	W	U	E	P	R			X								#						Irregular appearance
Cedar waxwing (*Bombycilla cedrorum*)	W	U	E	P	R			X								#						Irregular appearance
Northern shrike (*Lanius excubitor*)	W	UC	E	P	R	#	X		X	X			X	X	X	X						
Loggerhead shrike (*Lanius ludovicianus*) X	S	UC	E	P	R	#	X		X	X			X	#	X	X						
Starling (*Sturnus vulgaris*)	Y	C	E	P											X	X						Common around towns and farms
Red-eyed vireo (*Vireo olivaceus*)	S	UC		P	R																	
Solitary vireo (*Vireo solitarius*)	S	C	E	P	R			X	X		X	X				X						
Warbling vireo (*Vireo gilvus*)	S	C	E	P	R			X				X				X						Known nester

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE			HABITAT TYPES 4/																REMARKS
						VEGETATION											AQUATIC					
						1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Orange-crowned warbler (Vermivora celata)	S	UC	E	P	R			X				X				X						
Virginia's warbler (Vermivora virginiae)	S	C	E	P	R			X			X											
Yellow warbler (Dendroica petechia)	S	C	E	P	R											#						
Yellow rumped warbler (Dendroica coronata)	S	C	E	P	R				X		X	X				#						
Black-throated gray warbler (Dendroica nigrescens)	S	C	E		R		X	X			X	X	X	X								
Townsend's warbler (Dendroica townsendi)	M	UC	E		R				#													
Northern waterthrush (Seiurus noveboracensis)	M	R	E													#						
Mac Gillivrays warbler (Oporornis tolmiei)	S	UC	E	P	R		X	X								X						
Yellowthroat (Geothlypis trichas)	S	UC	E		R											X	X	X	#			
Yellow-breasted chat (Ieteria virens)	S	UC	E	P	R											#	X	X	X			

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE				HABITAT TYPES 4/ VEGETATION											HABITAT TYPES 4/ AQUATIC					REMARKS
							1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Wilsons warbler (_Wilsonia pusilla_)	S	C	E			R											#						
American redstart (_Setophaga ruticilla_)	S	U				R											#						
House sparrow (_Passer domesticus_)	Y	C	E	G		R																	Most common in areas of human habitation
Bobolink (_Dolichonyx oryzivorus_)	S	R	E			R	X									X	X	X		X	X		
Western meadowlark (_Sturnella neglecta_)	S-Y	C	E	G	P	R	#								X	X							
Yellow-headed blackbird (_Xanthocephalus xanthocephalus_)	S	C	E	G		R												X	X	#	X		Cattail marshes
Red-winged blackbird (_Agelaius phoeniceus_)	S-Y	C	E	G	P	R	X									#	X	X		#	X		
Brewers blackbird (_Euphagus cyanocephalus_)	Y	C	E	G	P	R	X									X	X						Most common in areas of human habitation
Brown-headed cowbird (_Molothrus ater_)	S	C	E	G	P	R	X		X			X	X			X	X						
Common grackle (_Quiscalus quiscalus_)	U	U	E													X	X	X					

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL OCCURRENCE 3/				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Northern oriole (Icterus galbula)	S	C	E		P	R							X				X	X					Also areas of human habitation
Western tanager (Piranga ludoviciana)	M	C	E	G	P	R			X	#		X	X										
Black-headed grosbeak (Pheucticus melanocephalus)	S	C	E	G	P	R			X	X		X	X				X						
Indigo bunting (Passerina cyanea)	U	U				R			#					X	X		X						
Lazuli bunting (Passerina amoena)	S	C	E		P	R		X	X				X	X	X		X						Especially in Riparian
Evening grosbeak (Hesperiphona vespertina)	Y	UC	E							#							X						
Cassins finch (Carpodacus cassinii)	Y	C	E		P	R				#		X	X										
House finch (Carpodacus mexicanus)	Y	C	E	G	P	R		X	#			X		X	X	X	#						Common in areas of human habitation
Pine grosbeak (Pinicola enucleator)	Y	UC	E		P	R			X	#		X											
Gray-crowned rosy finch (Leucosticte tephrocotis)	W	U	E			R			X	X	#	X											

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Black rosy finch (*Leucosticte altrata*)	W	C	E			R			X	X	#	X											
Brown-capped rosy finch (*Leucosticte australis*)	W	UC	E			R			X	X	#	X											
Pine siskin (*Spinus pinus*)	W	C	E		P	R				#		X	X				X						
American goldfinch (*Spinus tristis*)	Y	C	E	G	P	R			X				X				#						
Lesser goldfinch (*Spinus psaltris*)	S	UC	E		P	R			X	X		X	X				X						
Red crossbill (*Loxia curvirostra*)	U	U	E		P	R				#													Irregular movements
Green-tailed towhee (*Chlorura chlorura*)	M-S	C	E		P	R		X	#			X		X	X								Known nester
Rufous-sided towhee (*Pipilo erythrophthcalmus*)	U	C	E		P	R		X	#			X			X		X						
Lark bunting (*Calamospiza melanocorys*)	S	UC	E			R	X				X			X	X								
Savannah sparrow (*Passerculus sandwishensis*)	M	UC	E			R	X										X			X			

SPECIES[1/] WILD FAUNA	SEASON[2/] OF USE		REGIONAL OCCURRENCE[3/]				HABITAT TYPES[4/]																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Vesper sparrow (Pooecetes gramineus)	S	C	E		P	R	X	#						X	X		X						
Lark sparrow (Chondestes grammacus)	S	C	E		P	R		X	X					X	X	X							
Sage sparrow (Amphispiza belli)	S	C	E	G		R		#	X					X	X								Known nester
Dark-eyed junco (Junco hyemalis)	W	C	E		P	R			X	#		X					X						
Gray-headed junco (Junco caniceps)	Y	C	E		P	R			X	#		X	X				X						
Tree sparrow (Spizella arborea)	W	UC	E			R	X	X	X					X	X		X						
Chipping sparrow (Spizella passerina)	S	C	E	G	P	R		X				X	X				X						
Brewer's sparrow (Spizella breweri)	S	C	E	G	P	R		#	X					X	X								
White-crowned sparrow (Zonotrichia leucophrys)	Y	C	E	G	P	R		X	X					X	X								
Lincoln's sparrow (Melospiza lincolnii)	S	C	E		P	R							X				X	X		X			

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10a	13	14	19	20	1	2	3	4	5	
Song sparrow (*Melospiza melodia*)	Y	C	E P R	X		X								X	X		X			Known nester
Fox sparrow (*Passerella iliaca*)	S	U	E R							X				X	X		X			

S P E C I E S 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
				VEGETATION											AQUATIC					
				1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
AMPHIBIANS & REPTILES																				
Tiger salamander (Ambystoma tigrinum)	Y	U	E P R	X	X	X	X		X	X				X	X	X	X	X		
Western toad (Bufo boreas)	Y	U	E P R	X		X				X				X	X	X	X	X	X	
Woodhouse's toad (Bufo woodhousei)	Y	U	E	X	X						X	X		X	X	X	X			
Chorus frog (Pseudacris triseriata)	Y	U	E P R	X									X	#	#		X	X		
Leopard frog (Rana pipiens)	Y	U	E P R											X	#	#	X	X		
Collared Lizard (Crotaphytus collaris)	Y	U			X	X		#			X	X								
Eastern fence lizard (Sceloperus undulatus)	Y	U	E P R		X	X	X	X	X	X	X	X	X	X						
Sagebrush lizard (Sceloperus graciosus)	Y	U	E P		#	X	X		X					X						
Tree lizard (Urosausus ornatus)	Y	U	E R			X	X		X					X						
Side-blotched lizard (Uta stansburiana)	Y	U	E W R	X	X			X			X	X		X						

SPECIES 1/ WILD FAUNA	SEASON 2/ OF USE		REGIONAL OCCURRENCE 3/				HABITAT TYPES 4/																REMARKS
							VEGETATION											AQUATIC					
							1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Short-horned lizard (*Phrynosoma douglassi*)	Y	U	E			R	X	X	X	X	X	X											
Western whiptail (*Cnemidophorus tigris*)	Y	U	E									X		X	X		X						
Striped whipsnake (*Masticophis taeniates*)	Y	U	E			R	X	X	X	X		X		X	X	X	X						
Smooth green snake (*Opheodrys vernalis*)	Y	U	E	P			X				X						#						
Gopher snake (*Pituophis melanoleucus*)	Y	U	E			R	X	X	X	X		X	X	X	X	X	X						
Milk snake (*Lampropeltis triangulum*)	Y	U	E							X	X	X				X	X						
Western terrestrial garter snake (*Thamnophis elegans*)	Y	U	E	P	W	R	X	X	X	X		X		X	X		X						
Western rattlesnake (*Crotalus viridis*)	Y	U	E	P	W	R	X		X	X	#	X					X						

SPECIES 1/	SEASON 2/ OF USE	REGIONAL 3/ OCCURRENCE	HABITAT TYPES 4/																REMARKS
			VEGETATION											AQUATIC					
DOMESTIC FAUNA			1	4	5	6	7	9	10 a	13	14	19	20	1	2	3	4	5	
Horse (Equus sp.)																			
Cow (Bos sp.)																			
Sheep (Ovis sp.)																			
Cats (Felis domesticus)																			
Dogs (Canis familiaris)																			

TABLE VIII-2

Browse Plant Condition, Colowyo Mine, 1975

Transect	Production Index	Growth Index	Use Index	Utilization
#1 Oak	3.6	3.5	46.4	11.9
#1 Big Sage	6.6	6.6	9.9	1.5
#1 Bitterbrush	No use			
#1 Serviceberry	3.9	3.3	30.4	7.8
#1 Snowberry	No use (snow covered)			
#2 Oak	5.7	4.9	83.8	14.7
#2 Big Sage	5.0	5.0	17.0	3.4
#2 Serviceberry	4.7	3.8	146.2	31.1

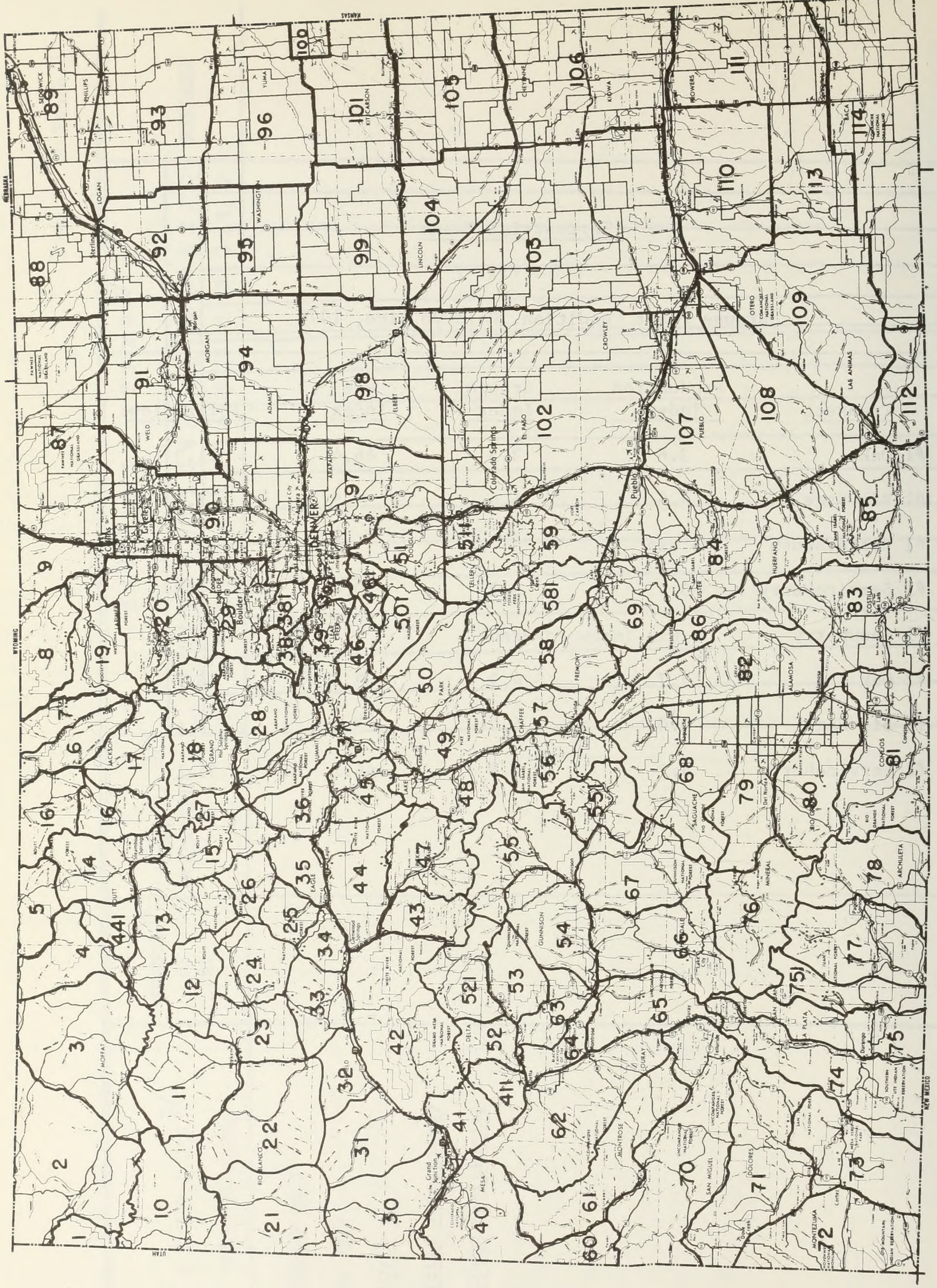

FIGURE VIII-1

Aquatic Biology

APPENDIX D

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FOR
AQUATIC BIOLOGY

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TABLE IX-1

Critical Habitat and Spawning Period Criteria for Fish Species Found in Study Region

Common Name	Scientific Name	Habitat Preferences	Spawning Period	Status of Species in Analysis Area 2/
Rainbow Trout	*Salmo gairdneri*	Water temperature of 50-60° F; can adapt to almost any coldwater environment; exhibit best growth in warmer, richer lakes and streams at lower elevations	Spring, April to June	Most abundant game fish in analysis area; frequently stocked in both lakes and streams by Colorado Division of Wildlife on an annual basis
Brook Trout	*Salvelinus fontinalis*	Water temperature of 55-66°F; mountain streams and lakes above 9,000 feet	Fall, generally October	Common; mainly in lakes and small, clear streams at high elevations
Cutthroat Trout	*Salmo clarki*	Prefer colder water than their near relative, the rainbow; typically found in headwaters of high mountain streams and in mountain lakes	Spring, April to June	Only trout native to Colorado; abundance has been greatly reduced; present, usually at higher elevations
Brown Trout	*Salmo trutta*	Most versatile of trouts; can adjust to almost any cold water habitat	Fall, normally October	Present, generally in larger streams and lakes at lower elevations
Mountain Whitefish	*Prosopium williamsoni*	Larger rivers with good pools, three or four feet deep with riffle areas and gravel bottoms	Fall	Present in larger drainages such as the Yampa and Elk Rivers
Longnose Sucker	*Catostomus catostomus*	High lakes, reservoirs and streams	Late Spring	Present in major drainages
White Sucker	*Catostomus commersoni*	Lakes and reservoirs; pools in streams where there is much cover from bank vegetation	Spring and early Summer	Abundant in reservoirs, lakes, and tributary streams
Colorado Squawfish 1/	*Ptychocheilus lucius*	Historically, larger streams in Colorado River Basin	Early Spring	Present in Yampa and White Rivers
Channel Catfish	*Ictalurus punctatus*	Warm water rivers and reservoirs	Late Spring or early Summer	Present in lower, warm reaches of larger streams and in warm water lakes
Carp	*Cyprinus carpio*	Warm shallow water with plenty of aquatic vegetation	Late May to early June	Present in Little Snake, Yampa, and White Rivers and Rio Blanco Lake

1/ Endangered Species

2/ Abundant = species is plentiful in analysis area
Common = species is found regularly in analysis area
Present = species is found occasionally in analysis area

TABLE IX-1 (Cont.)

Critical Habitat and Spawning Period Criteria for Fish Species Found in Study Region

Common Name	Scientific Name	Habitat Preferences	Spawning Period	Status of Species 2/ in Analysis Area
Bonytail Chub 1/	Gila elegans	Historically, larger streams in the Colorado River Basin	Late June to early July	Present in Yampa and White Rivers
Humpback Chub 1/	Gila cypha	Historically, canyon areas of large streams in the Colorado River Basin	Not known	Present in Yampa and White Rivers
Humpback Sucker 1/	Xyrauchen texansus	Historically, in slack waters of large rivers or impoundments Colorado River system	March to June	Present in Yampa and White Rivers
Mottled Sculpin	Cottus bairdi	Small mountain trout streams	Spring	Common in trout streams
Green Sunfish	Lepomis cyanellus	Warm water fisheries habitats	June to mid-August	Present in Axial Basin and Ralph White Reservoirs
Black Bullhead Catfish	Ictalurus molas	Warm water fisheries habitats	Late spring or early summer	Present in Axial Basin and Ralph White and Rio Blanco Reservoirs
Northern Pike	Esox lucius	Warm water lakes and reservoirs	Early spring	Present in Ralph White and Rio Blanco Reservoirs
Yellow Perch	Perca flavescens	Warm water fluctuating reservoirs	Spring	Present in Axial Basin Reservoir
Black Crappie	Pomoxis nigromalulatus	Clear, weedy lakes	Spring	Present in Axial Basin Reservoir
Largemouth Bass	Micropterus salmoides	Warm water, fluctuating, heavily vegetated reservoirs	Late May through June	Present in Axial Basin Reservoir
Kokanee Salmon	Oncorhynchus nerka	Large, fluctuating mountain reservoirs	Mid-October to late December	Present in Crosho Lake
Speckled Dace	Rhinichthys osculus	Small to moderate-sized swift streams	Spring?	Common in trout streams

1/ Endangered Species

2/ Abundant = species is plentiful in analysis area
Common = species is found regularly in analysis area
Present = species is found occasionally in analysis area

TABLE IX-2

Characteristics Pertinent to the Evaluation of Stream Fisheries in the Study Region

Stream Name	Drainage System Name	Value Rating*	Fish Species Present (Percent of Total Population)	Mean Stream Flow (cfs)	Mean Stream Width (Feet)	Populations Being Maintained By Stocking (Species)	Populations Being Maintained By Natural Reproduction (Species)	Overall Population Conditions
Routt County								
Bear C	Hot Springs-Elk	75	B(100)	2.0	3	No	Abundant (B)	Overpopulated (B)
Beaver C	SF Williams F	84	B(50), C(50)	1.5	4	Rarely	Some	Stable
Beaver C	Willow C	80	B(60), C(20), R(20)	10.0	5	Occasionally	Abundant (B)	Stable
Deep C	Elk R	55	B(10), C(10), R(70), W(10)	4.0	7	Rarely	Some	Stable
Egeria C	Rock C	72	B(1t), C(15), R(70)	E8.0	E4	Regularly	Some	Underpopulated
Elk R	Yampa R	73	B(5), Br(5), C(5), R(50) W(15), Rough(20)	500.0	50	Regularly	Some	Stable
Elkhead C	Yampa R	70	B(30), C(40), R(30)	NA	E11	Regularly	Some	Stable
Finger Rock C	Yampa R	73	B(50), Br(50)	E1.0	E2	No	Some	Stable
Fish C	Trout C	67	B(50), C(50)	3.0	6	No	Some	Stable
Hunt C	Yampa R	57	R(90), S(10)	E2.0	E3	Rarely	Some (s)	Underpopulated
Middle C	Trout C	50	B(50), R(50)	E2.0	E3	Occasionally	Some	Stable
Morrison C	Yampa R	40	B(100)	E2.0	E3	Regularly	Abundant (B)	Overpopulated (B)
Oak C	Yampa R	40	R(100)	2.0	4	Regularly	No	Stable
Second C	EF Williams F	50	R(100)	0.5	2	No	Some	Stable
Slater C	Little Snake R	85	B(30), Br(5), C(5), R(60)	20.0	15	Regularly	Some (B, Br, C)	Stable
Little Snake R	Yampa R	88	B(5), Br(10), C(5), R(80)	150.0	70	Regularly	Some	Stable
MF Snake R	Yampa R	83	B(30), R(70)	20.0	20	Regularly	Some (B)	Stable
SF Snake R	Yampa R	77	B(30), R(70)	8.0	10	No	Some	Stable
Soda C	Yampa R	48	B(100)	2.0	3	Regularly	Abundant (B)	Overpopulated (B)
Spring C	Yampa R	52	B(70), R(30)	0.5	3	Regularly	Abundant (B)	Overpopulated (B)
Tow C	Yampa R	73	C(100)	7.0	10	Occasionally	Some	Stable
Walton C	Yampa R	47	B(99), R(T)	E4.0	E5	Regularly	Abundant (B)	Overpopulated (B)
Williams Fork R	Yampa R	93	Br(10, C(10, R(80)	30.0	30	Regularly	Some (Br)	Stable
SF Williams F R	Yampa R	80	C(40), R(60)	E5.0	E10	Occasionally	Some	Stable
Willow C	Elk R	83	B(20), C(10), R(60), W(10)	E20.0	10	Regularly	Some	Stable
Yampa R	Service C to Bear R	40	Br(5), R(80), S(10), W(5)	NA	E15	Regularly	Abundant (S)	Overpopulated (S)

SOURCE: Colorado Division of Wildlife, 1972.

Abbreviations Used - NA, (Data) Not available; E, Estimated

STREAM NAME - DRAINAGE SYSTEM: C, Creek; R, River; F, Fork; S, South; H, North; E, East

FISH SPECIES PRESENT: B, Brook Trout; C, Cutthroat Trout; R, Rainbow Trout; Br, Brown Trout; S, Suckers; W, Whitefish; Rough, Rough Fish; Cb, Chub; Ca, Carp; CC, Channel Catfish; Sq, Squawfish; Sc, Sculpin

*VALUE RATING SYSTEM: 60 and below, Poor; 61-74, Fair; 75-85, Good; 86 and above, Excellent

TABLE IX-2 (Cont.)

Characteristics Pertinent to the Evaluation of Stream Fisheries in the Study Region

Stream Name	Drainage System Name	Value Rating*	Fish Species Present (Percent of Total Population)	Mean Stream Flow (cfs)	Mean Stream Width (Feet)	Populations Being Maintained By Stocking (Species)	Populations Being Maintained By Natural Reproduction (Species)	Overall Population Conditions
Moffat County								
Little Bear C	Fortification C	100	B(30), C(40), R(30	1.5	2	Regularly	Some (c)	Underpopulated
Beaver C	Slater C	68	B(70), C(30)	1.5	3	Rarely	Abundant (B)	Overpopulated (B)
Deer C	Morapos C	88	B(30), C(70)	2.0	4	Occasionally	Some	Stable
Fortification C	Yampa River	95	B(40), C(40), R(20)	1.5	4	Occasionally	Some (B,C,R)	Overpopulated (B)
Green R	Colorado R	60	R(70), Br(5), Ca(10), Sq(T), S(10)	3,000	200	Regularly	Some	Stable
Little Snake R 1	Yampa R							
Little Snake	Wyoming to Powder Wash	85	B(2.5) Br(5), C(2.5), R(90)	150.0	70	Regularly	Some	Stable
Talamanies C	Vermillion C	88	Ca(80), Cc(120), Sq(T), S(T)	NA	E30	No	Abundant	Overpopulated
Yampa R	Lily Park to Maybelle	78	B(80), C(10), R(10)	1.0	2	Occasionally	Some	Stable
Yampa R	Green R to Maybelle	80	Cb(30), Cc(45), Br(5) R(5), Sq(15)	700.0	100	No	Some	Stable
Yampa R	Lily Park to Maybelle	63	W(10), Cc(5), (Br(5), R(10) Rough (70)	NA	E30	Regularly	Abundant (Rough)	Overpopulated (Rough)
Rio Blanco County								
Coal C	Little Beaver C	80	B(90), R(10)	8.0	6	No	Some	Underpopulated
Fish C	Yampa R	38	B(70), R(30)	0.5	5	Occasionally	Some	Stable
Morapos C	Williams F R	67	C(50), R(50)	3.0	6	Occasionally	Some	Stable
Pagoda C	S F Williams R	100	C(100)	3.0	6	No	Some	Stable
Trout C	Yampa R	43	B(80), C(10), R(10)	5.0	10	Regularly	Some	Stable
White R	Utah to Strawberry C	60	Br(10, Ca(10), Cc(30), Sc(10), Cb(10), S(10), R(10), W(10)	500.0	70	Rarely	Abundant (Cc, S,W)	Stable
N F White R	White R.	92	B(20), C(20), Br(15), R(25), W(15), S(5)	300.0	40	Regularly	Some	Stable
E F Williams F R	Yampa R	100	C(90), R(5), W(5)	14.0	20	Occasionally	Some	Stable

SOURCE: Colorado Division of Wildlife, 1972.

Abbreviations Used: NA, (Data) Not Available; E, Estimated
STREAM NAME - DRAINAGE SYSTEM: C, Creek; R, River; F, Fork; S, South; N, North; E, East
FISH SPECIES PRESENT: B, Brook Trout; C, Cutthroat Trout; R, Rainbow Trout; Br, Brown Trout; S, Suckers; W, Whitefish Rough, Rough fish; Cb, Chub; Ca, Carp; CC, Channel Catfish; Sq, Squawfish; Sc, Sculpin
*VALUE RATING SYSTEM: 60 and below, Poor; 61-74, Fair; 75-85, Good; 86 and above, excellent

TABLE IX-2 (Cont.)

Characteristics Pertinent to the Evaluation of Lake Fisheries in the Study Region

Lake Name	Drainage System Name	Township and Range	Section	Average Surface Acres	Maximum Maximum Depth	Fish Species Present (Percent of Total Population	Populations Being Maintained By Stocking (Species)	Populations Being Maintained by Natural Reproduction (Species)	Overall Population Conditions
Routt County									
Gill Re	E F Williams F	3N88W	11	7	E8	C(100)	Rarely	Rarely	Under
Hahns Peak L	Willow C	10N86W	12	40	45	B(T), R(75), S(25)	Regularly	Common	Stable
Pearl L	Lester C	10N85W	35	167	83	B(10), C(60), R(10),S(20)	Occasionally	Common	Under
Sage Creek Re	Sage C	5N88W	13	20	E30	R(100)	No	Rarely	Under
Steamboat L	Willow C	10N86W	35	1,083	85	B(10), Br(5), C(T), R(85)	Regularly	Common	Stable
Moffat County									
Butch Cassidy Re	Green R	10N104W	12	100	17	B(90), C(8), R(2)	Rarely	Some	Stable
Freeman Re	Cottonwood C	9N89W	6	14	E30	C(100)	Occasionally	Rarely	Under
Hog L	Green R	10N103W	9	51	15	B(100)	Rarely	Rarely	Under
Ralph White L	Fortification C	8N90W	26	40	E15	Su(49), Bh(30), Cc(10), Np(1), R(10)	Regularly	Abundant	Over (Bg, Bh)
Rio Blanco County									
Axial Basin Re	Milk C	4N93W	13	20	E10	Bh(10), Su(3), R(80), Yp(3), Cc(2), Cr(2)	Regularly	Common	Stable
Chapman Re	Oak C	3N86W	31	25	26	B(T), C(T), R(99)	Regularly	Rarely	Stable
Pagoda L	Snell C	2N89W	23	7	16	B(90), R(10)	Occasionally	Rarely	Under
Rio Blanco L	White R	1N96W	6	120	15	Cb(10), Cp(50), S(20)Cc(10), Np(5), Bh(3), R(2)			
Sheriffs Re	Trout C	2N87W	20	40	E30	R(100)	Regularly	Rarely	Stable
Vaughn L	Poose C	2N88W	22	36	26	R(99), C(T)	Regularly	Rarely	Stable

SOURCE: Colorado Division of Wildlife, 1972

Abbreviations Used - LAKE NAME - DRAINAGE SYSTEM: C, Creek; L, Lake; Re, Reservoir; E, East; F, Fork
MAXIMUM DEPTH: E, Estimated
FISH SPECIES PRESENT: C, Cutthroat Trout; B, Brook Trout; R, Rainbow Trout; S, Sucker; Br, Brown Trout; Su, Sunfish; Bh, Bullhead Catfish; Cc, Channel Catfish; Np, Northern Pike; Yp, Yellow Perch; Cr, Crappie; Lmb, Largemouth Bass; K, Kokanee Salmon; Cb, Chub; Cp, Carp; (T), trace of species found in habitat.
OVERALL POPULATION CONDITION: Under, underpopulated; Over, overpopulated.

TABLE IX-3

Chemical Analyses for Upper Dry Creek in March, April and June 1974

Parameters	Mar 11	Apr 29	Jun 25	Aug	Oct	Dec	Mean
Dissolved Oxygen (mg/l)	10.6	8.3	7.0				
pH	8.54	8.52	7.7				
Temperature (^{o}C)	5.2	13.0	20.0				
Turbidity (JTU)	7	0	0				
PHTH Alkalinity ($CaCo_3$) (mg/l)	0	5	-				
Total Alkalinity ($CaCO_3$) (mg/l)	313	235	360				
Chloride (mg/l)	3.5	2.7	6.7				
Sulfate (mg/l)	199	118	200				
Calcium (mg/l)	95	59	99				
Magnesium (mg/l)	55	32	57				
Sodium (mg/l)	48	19	21				
Potassium (mg/l)	3.9	5.5	7.0				
Fluoride (mg/l)	-	0.72	0.84				
Silica (SiO_2) (mg/l)	12	8.5	15				
Specific Conductance (µmhos/cm)	961	610	958				
Total Dissolved Solids (mg/l)	692	* 372	708				
Ammonia (N) (mg/l)	0.28	< 0.1	0.35				
Nitrate (N) (mg/l)	0.29	0.30	0.13				
Kjeldahl (N) (mg/l)	<0.1	0.60	0.66				
Phosphorous, Ortho (mg/l)	<0.1	0.12	<0.1				
Phosphorous, Total (mg/l)	<0.1	0.22	<0.1				
Phosphorous, Soluble (mg/l)	-	0.12	<0.1				
BOD, 5 day (mg/l)	6.6	9.0	10				
BOD, 20 day (mg/l)		11.0	22				
Total Coliforms (MPN/100ml)	>2,400	>2,400	93				
Fecal Coliforms	23	4	<3				
COD	-	-	-				

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* Analyses are for combined upper and lower Dry Creek.

TABLE IX-4

Chemical Analyses for Northern Tributary to Dry Creek in May and June 1974

Parameters	May 29		June 25	Aug 25	Oct	Dec	Mean
Dissolved Oxygen (mg/l)	-		6.0				
pH	-		7.9				
Temperature (^oC)	-		25				
Turbidity (JTU)	-		-				
PHTH Alkalinity ($CaCo_3$) (mg/l)	-		-				
Total Alkalinity ($CaCO_3$) (mg/l)	-		310				
Chloride (mg/l)	4.9		12				
Sulfate (mg/l)	914		594				
Calcium (mg/l)	220		127				
Magnesium (mg/l)	158		109				
Sodium (mg/l)	30		65				
Potassium (mg/l)	7.2		13				
Fluoride (mg/l)	1.3		0.70				
Silica (SiO_2) (mg/l)	16		8.5				
Specific Conductance (µmhos/cm)	1,973		1,489				
Total Dissolved Solids (mg/l)	1,856	*	1,252				
Ammonia (N) (mg/l)	<0.1		<0.1				
Nitrate (N) (mg/l)	0.45		0.11				
Kjeldahl (N) (mg/l)	0.25		0.86				
Phosphorous, Ortho (mg/l)	<0.1		<0.1				
Phosphorous, Total (mg/l)	<0.1		<0.1				
Phosphorous, Soluble (mg/l)	<0.1		<0.1				
BOD, 5 day (mg/l)	8		8				
BOD, 20 day (mg/l)	15		16				
Total Coliforms (MPN/100 ml)	1,100		120×10^2				
Fecal Colif (MPN/100 ml)	3		23				
COD	19		-				

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* Analyses are for combined upper and lower Sage Creek samples.

TABLE IX-5

Chemical Analyses for Lower Dry Creek in March, April and June 1974

Parameters	Mar 11	Apr 29	Jun 25	Aug	Oct	Dec	Mean
Dissolved Oxygen (mg/1)	10.6	8.58	6.0				
pH	8.54	-	7.8				
Temperature (^oC)	2.0	10.0	23.5				
Turbidity (JTU)	20	620	5				
PHTH Alkalinity ($CaCO_3$) (mg/1)	0	0	-				
Total Alkalinity ($CaCO_3$) (mg/1)	370	235.0	295				
Chloride (mg/1)	3.5	3.0	8.5				
Sulfate (mg/1)	199	167.0	374				
Calcium (mg/1)	95	86.0	99				
Magnesium (mg/1)	55	44.0	77				
Sodium (mg/1)	48	18.0	44				
Potassium (mg/1)	3.9	6.6	7.0				
Fluoride (mg/1)	-	0.72	0.72		(discontinued)		
Silica (SiO_2) (mg/1)	12	10.3	9.0				
Specific Conductance (μmhos/cm)	961	678	1,136				
Total Dissolved Solids (mg/1)	692 *	470	862				
Ammonia (N) (mg/1)	0.28	<0.1	<0.1				
Nitrate (N) (mg/1)	0.29	0.85	<0.1				
Kjeldahl (N) (mg/1)	<0.1	2.6	0.84				
Phosphorous, Ortho (mg/1)	<0.1	<0.1	<0.1				
Phosphorous, Total (mg/1)	<0.1	<0.18	<0.1				
Phosphorous, Soluble (mg/1)	-	<0.1	<0.1				
BOD, 5 day (mg/1)	6.6	12	8				
BOD, 20 day (mg/1)		14	18				
Total Coliforms (MPN/100 ml)	>2,400	>2,400	39				
Fecal Coliforms (MPN/100 ml)	23	<15	9				
COD	-	-	-				

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* Analyses are for combined upper and lower Dry Creek.

TABLE IX-6

Chemical Analyses for Upper Sage Creek in March, April and June 1974

Parameters	Mar 11		Apr 29	Jun 25	Aug	Oct	Dec	Mean
Dissolved Oxygen (mg/1)	9.0		9.7	7.0				
pH	-		8.6	7.3				
Temperature (^{o}C)	6.0		5.0	16.0				
Turbidity (JTU)	0		5	10				
PHTH Alkalinity ($CaCO_3$) (mg/1)	0		0	-				
Total Alkalinity ($CaCO_3$) (mg/1)	229		141	215				
Chloride (mg/1)	1.5		0.2	1.0				
Sulfate (mg/1)	133		31.9	26				
Calcium (mg/1)	80		34	54				
Magnesium (mg/1)	40		15	24				
Sodium (mg/1)	19		3.1	4.3	(discontinued)			
Potassium (mg/1)	3.3		2.0	2.3				
Fluoride (mg/1)	-		0.5	0.56				
Silica (SiO_3) (mg/1)	7.5		9.0	12				
Specific Conductance (µmhos/cm)	702		291	459				
Total Dissolved Solids (mg/1)	494	*	152	294				
Ammonia (N) (mg/1)	.23		<0.1	0.32				
Nitrate (N) (mg/1)	.40		<0.1	<0.1				
Kjeldahl (N) (mg/1)	<0.1		0.48	0.56				
Phosphorous, Ortho (mg/1)	<0.1		<0.1	<0.1				
Phosphorous, Total (mg/1)	<0.1		0.18	<0.1				
Phosphorous, Soluble (mg/1)	-		<0.1	<0.1				
BOD, 5 day (mg/1)	2.4		9	6				
BOD, 20 day (mg/1)			12	11				
Total Coliforms (MPN/100 ml)	28		460	460				
Fecal Coliforms (MPN/100 ml)	<3		<2	<3				
COD	-		-	-				

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* Analyses are for combined upper and lower Sage Creek samples.

TABLE IX-7

Chemical Analyses for Sage Creek below Sage Creek Reservoir in April and June 1974 [1/]

Parameters	Mar 11	Apr 29	Jun 25	Aug	Oct	Dec	Mean
Dissolved Oxygen (mg/1)	(not sampled)	8.8	7.5				
pH		8.5	7.5				
Temperature (°C)		7.0	16.0				
Turbidity (JTU)		0	20				
PHTH Alkalinity ($CaCO_3$) (mg/1)		0	-				
Total Alkalinity ($CaCO_3$) (mg/1)		228.5	155				
Chloride (mg/1)		0.2	1.0				
Sulfate (mg/1)		258	64				
Calcium (mg/1)		103	48				
Magnesium (mg/1)		45	22				
Sodium (mg/1)		16	7.3	(discontinued)			
Potassium (mg/1)		5.3	4.2				
Fluoride (mg/1)		0.6	0.49				
Silica (SiO_3) (mg/1)		9.2	9.0				
Specific Conductance (μmhos/cm)		852	437				
Total Dissolved Solids (mg/1)		608	304				
Ammonia (N) (mg/1)		0.1	<0.1				
Nitrate (N) (mg/1)		0.43	0.27				
Kjeldahl (N) (mg/1)		0.62	0.74				
Phosphorous, Ortho (mg/1)		<0.1	<0.1				
Phosphorous, Total (mg/1)		0.14	<0.1				
Phosphorous, Soluble (mg/1)		<0.1	<0.1				
BOD, 5 day (mg/1)		5	3				
BOD, 20 day (mg/1)		7	8				
Total Coliforms (MPN/100 ml)		460	240				
Fecal Coliforms (MPN/100 ml)		<2	<3				
COD		-	-				

[1/] Analyses area for combined upper and lower Sage Creek samples.

TABLE IX-8

Chemical Analyses of Lower Sage Creek in March, April and June 1974[1/]

Parameters	Mar 11	Apr 29	Jun 25	Aug	Oct	Dec	Mean
Dissolved Oxygen (mg/1)	10.5	8.1	8.7				
pH	8.68	8.65	8.1				
Temperature (^{O}C)	4.2	11.5	16.5				
Turbidity (JTU)	6	180	0				
PHTH Alkalinity ($CaCO_3$)(mg/1)	0	0	-				
Total Alkalinity ($CaCO_3$) (mg/1)	272	205	160				
Chloride (mg/1)	1.5	0.3	1.0				
Sulfate (mg/1)	133	109	82				
Calcium (mg/1)	80	57	58				
Magnesium (mg/1)	40	30	28				
Sodium (mg/1)	19	12	6.8				
Potassium (mg/1)	3.3	5	4.2				
Fluoride (mg/1)	-	0.66	0.50				
Silica (SiO_2) (mg/1)	7.5	10	8.4				
Specific Conductance (μmhos/cm)	702	552	496				
Total Dissolved Solids (mg/1)	494 *	308	328				
Ammonia (N) (mg/1)	.23	<0.1	<0.1				
Nitrate (N) (mg/1)	.40	1.3	0.32				
Kjeldahl (N) (mg/1)	<0.1	1.7	0.60				
Phosphorous, Ortho (mg/1)	<0.1	<0.1	<0.1				
Phosphorous, Total (mg/1)	<0.1	0.22	<0.1				
Phosphorous, Soluble (mg/1)	-	0.1	<0.1				
BOD, 5 day (mg/1)	2.4	11	6				
BOD, 20 day (mg/1)	-	13	14				
Total Coliforms (MPN/100 ml)	28	75	75				
Fecal Coliforms (MPN/100 ml)	<3	<2	<3				
COD	-	-	-				

[1/] Analyses are for combined upper and lower Sage Creek samples.

TABLE IX-9

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in Upper Dry Creek

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Tricladida		80		7.2%
Planariidae/*Phagocata* sp.	A		80	
Gastropoda		12		1.1%
Planorbidae/Unknown genus	A		4	
Physidae/*Physa* sp.	A		2	
Lymnaeidae/*Lymnaea* sp.	A		6	
Pelycepoda		483		43.4%
Sphaeriidae/*Pisidium* sp.	A		250	
Sphaeriidae/*Sphaerium* sp.	A		233	
Isopoda		7		0.6%
Gammaridae/*Gammarus* lacustrus	A		2	
Hyalellidae/*Hyalella azteca*	A		5	
Ephemeroptera		373		33.5%
Baetidae/*Baetis* sp.	A		373	
Plecoptera		2		0.2%
Nemouridae/*Nemoura* sp.	N		2	
Trichoptera		14		1.3%
Limnephilidae/*Hesperophylax* sp.	L		6	
Hydropshychidae/*Hydropsyche* sp.	L		8	
Coleoptera		6		0.5%
Elmidae/Unknown	L		6	
Diptera		136		12.2%
Chironomidae	L/P		40/6	
Simulidae/*Simulium* sp.	L/P		80/8	
Tipulidae/*Eriocera* sp.	L		2	
Total		1,113		100.0%

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-10

Number and Relative Abundance (by order) of Benthic Animals Caught with a Surber Sampler in Upper Dry Creek

Order Family/Taxon	Growth Stage 1/	Number2/		Relative Abundance
Oligochaeta		4		1.0%
Tubificidae	A		4	
Hydracarina	A	1		0.2%
Turbellaria		40		9.7%
Planaridae/poss. _Phagocota_ sp.	A		40	
Gastropoda		3		0.7%
Physidae/_Physa_ sp.	A		1	
Phanoribidae/poss. _Heliosoma campanulata_	Immat		2	
Pelycepoda		120		29.2%
Sphaeridae/_Sphaerium_ sp.	A		120	
Amphipoda		31		7.5%
Hyalellidae/_Hyalella_ _azteca_	A		28	
Gammaridae/_Gammarus_ _lacustris_	A		3	
Ephemoroptera		67		16.3%
Bactidae/_Baetis_ sp.	N		67	
Plecoptera		7		1.7%
Nemouridae/_Nemoura_ sp.	N		7	
Trichoptera		1		0.2%
Limnephilidae/_Hesperophylax_ sp.	P		1	
Coleoptera		7		1.7%
Elmidae	L		4	
Dytiscidae	L		1	
Unknown	L		1	
Unknown	A		1	

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-10 (Cont.)

Number and Relative Abundance (by order) of Benthic Animals Caught with a Surber Sampler in Upper Dry Creek

Order Family/Taxon	Growth Stage 1/	Number 2/	Relative Abundance
Diptera		130	31.8%
Tipulidae/*Tipula* sp.	L	8/1	
poss. *Dicranota* sp.	L	3	
poss. *Eriocera* sp.	L	4	
Stratiomyiidae/Unknown "A"	L	7/2	
Unknown "B"	L	4	
Unknown "C"	L	1	
Simulidae	L	16/7	
	P	9	
Chironomidae	L	99/59	
	P	40	
Total		411	100.0%

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-11

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in Hubberson Gulch Near Confluence with Dry Creek

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Oligochaeta	A	2		1.9%
Tubificidae			2	
Hirudinea	A	1		0.9%
Gastropoda		3		2.9%
Physidae/*Physa* sp.	A		2	
Unknown	A		1	
Amphipoda		8		7.6%
Hyallelidae/*Hyallela azteca*	A		6	
Gammeridae/*Gammerus lacustris*	A		2	
Ephemeroptera		45		42.8%
Baetidae/*Baetis* sp.	N		45	
Plecoptera		9		8.6%
Perlodidae/*Isoperla patricia*	N		9	
Trichoptera		3		2.9%
Limnephilidae/*Hesperophylax* sp.	L		3	
Coleoptera				
Dytiscidae	A	2/1		1.9%
	L		1	
Diptera		32		30.5%
Simulidae	L		27	
Tipulidae/*Tipula* sp.	L		3	
Anthomyiidae/*Limnophora aquefrons*	L		1	
Chironomidae	L		1	
Total			105	100.0%

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-12

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in Lower Dry Creek

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Amphipoda		3		7.5%
Hyallelidae/Hyalella azteca	A		3	
Ephemeroptera		20		50.0%
Baetidae/Baetis sp.	N		20	
Trichoptera		6		15.0%
Hydropsychidae/Hydropsyche sp.	L		1	
Limnephilidae/Hesperophylax sp.	L		5	
Diptera		11		27.5%
Tipulidae/Tipula sp.	L		4	
Unknown genus	L		1	
Simulidae	L		4	
Chironomidae	L		2	
Total		40		100.0%

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-13

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in Upper Sage Creek

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Plesiopora		5		0.7%
Lumbriculidae	A		5	
Gastropoda		4		0.5%
Lymnaeidae/*Lymnaea* sp.	A		4	
Ephemeroptera		175		24.1%
Baetidae/*Callibaetis* sp.	N		3	
Baetidae/*Baetis* sp.	N		172	
Plecoptera		47		6.5%
Chloroperlidae/*Alloperla* sp.	N		18	
Perlodidae/*Isoperla patricia*	N		20	
Nemouridae/*Nemoura* sp.	N		9	
Trichoptera		42		5.8%
Limnephilidae/*Limnephilus* sp.	L		38	
Hesperophylax sp.	L		4	
Coleoptera		11		1.5%
Dytiscidae/*Agabinus* sp.	L		5	
Dytiscidae/*Agabinus* sp.	A		6	
Diptera		442		60.9%
Simulidae	L		417	
Chironomidae	L		22	
Tipulidae/*Dicranota* sp.	L		3	
Total			726	100.0%

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-14

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in Sage Creek below Sage Creek Reservoir

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Oligochaeta		82		40.3%
Lumbriculidae	A		82	
Gastropoda	A	1		0.5%
Amphipoda		6		3.0%
Hyalellidae/*Hyalella azteca*	A		6	
Ephemeroptera		34		16.8%
Baetidae/*Baetis* sp.	N		34	
Plecoptera		2		1.0%
Perlodidae/*Isoperla patricia*	N		2	
Trichoptera		2		1.0%
Limnephilidae/*Hesperophylax* sp.	L		2	
Coleoptera		2		1.0%
Elmidae/*Promoresia* sp.	L		2	
Diptera		74		36.4%
Tipulidae	L		1	
Simulidae	L		42	
Chironomidae	L		30	
Empediadae/poss. *Hemerodromia* sp.	L		1	
Total				

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-15

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in Lower Sage Creek

Order Family/Taxon	Growth Stage[1/]	Number[2/]	Relative Abundance
Oligochaeta		1	0.8%
Lumbriculidae	A	1	
Gastropoda	A	3	2.5%
Pelycepoda		6	4.9%
Sphaeridae/*Sphaerium* sp.	A	6	
Ephemeroptera		49	40.1%
Baetidae/*Baetis* sp.	N	49	
Plecoptera		21	17.2%
Perlodidae/*Isoperla patricia*	N	21	
Hemiptera		1	0.8%
Veliidae/*Microvelia* sp.	N	1	
Trichoptera		17	14.0%
Hydropsychidae/*Hydropsyche* sp.	L	3	
Limnephilidae/*Hesperophylas* sp.	L	10	
Unknown sp.	L	4	
Coleptera		16	13.1%
Elmidae/*Optioservus* sp.	L	11	
Heterlimnius sp.	A	5	
Diptera		8	6.6%
Tipulidae/*Eriocera* sp.	L	4	
Unknown genus	L	1	
Chironomidae	A	3	
Total		122	100.0%

[1/] Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

[2/] Numbers on left indicate total per order; numbers on right indicate total per species.

Aquatic Biology

TABLE IX-16

Number and Relative Abundance (by order) of Benthic Animals Caught with a Surber Sampler in Grassy Creek

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
(a. Middle of stream)				
Ephemeroptera		1		4.0%
Baetidae/*Baetis* sp.	N		1	
Diptera		24		96.0%
Chironomidae	L		22	
	P		2	
Fish eggs			6/3	
Fish larvae			3	
Total		25		100.0%
(b. Near stream bank)				
Oligochaeta		1		1.1%
Unknown			1	
Trichoptera		1		1.1%
Hydrophsychidae/*Cheumatopsyche* sp.			1	
Diptera		91		97.8%
Simulidae	L		2	
Chironomidae	L		83	
	P		6	
Total		93		100.0%

1/
Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/
Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-17

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in the "Mudslide" Lake in Section 15

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Oligochaeta		20		54.1%
Tubificidae	A		20	
Ephemeroptera		2		5.4%
Baetidae/*Callibaetis* sp.	A		1	
Baetis sp.	A		1	
Zygoptera		1		2.7%
Coenagrionidae/*Enallagma* sp.	N		1	
Hempitera		4		10.8%
Corixididae/*Hesperocorixa* sp.	N		4	
Coleoptera		4		10.8%
Dytiscidae/*Hydroporus* sp.	L		3	
Unknown sp.	A		1	
Diptera		6		16.2%
Chironomidae	L		6	
Salamander embryo			1	
Total		37		100.0%

1/ Growth stages include a - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

Aquatic Biology

TABLE IX-18

Number and Relative Abundance (by order) of Benthic Animals Caught with a Dip-net in the Uppermost Beaver Pond in Section 27

Order Family/Taxon	Growth Stage 1/	Number 2/		Relative Abundance
Oligochaeta		30		8.2%
Tubificidae	A		30	
Hirudinea		1		0.3%
Erpobdellidae	A		1	
Gastropoda		8		2.2%
Physidae/*Physa* sp.	A		8	
Acari	A	2/2		0.5%
Amphipoda		232		63.5%
Hyalellidae/*Hyalella azteca*	A		215	
Gammaridae/*Gammarus lacustris*	A		17	
Ephemeroptera		79		21.6%
Baetidae/*Callibaetis* sp.	N		52	
Beatis sp.	N		27	
Odonata		2		0.5%
Coenagrionidae/*Ischnura* sp.	N		2	
Hemiptera		3		0.8%
Corixidae/*Graptocorixa* sp.	A		1	
Unknown sp.	A		1	
Notonectidae/*Notonecta* sp.	A		1	
Trichoptera		3		0.8%
Limnephilidae/Unknown pupae	L/P		3	
Coleoptera		2		0.5%
Dyatiscidae	L		1	
Haliplidae	A		1	
Diptera		4		1.1%
Simulidae	A		1	
Chironomidae	A		3	
Total		366		100.0%

1/ Growth stages include A - adult, N - nymph, L - larvae, and P - pupal.

2/ Numbers on left indicate total per order; numbers on right indicate total per species.

TABLE IX-19

Numbers and Kinds of Benthic Macroinvertebrates Collected in One Surber Bottom Sample in July, August, and September, 1975 at Each Station, on Fish Creek 1/

Taxon	STATION Upper July	Upper Aug	Upper Sept	Middle July	Middle Aug	Middle Sept	Lower July	Lower Aug	Lower Sept
Class Insects: Insects									
Order Diptera: True Flies									
Family Heleidae: Biting Midges	1	-	3	-	-	-	-	2	12
Tendipedidae: Midges	7	7	20	-	398	361	-	1114	566
Simulidae: Black Flies	3	-	5	-	-	6	5	-	186
Tipulidae: Crane Flies	-	3	3	-	4	-	-	-	8
Rhagionidae: Snipe Flies	-	6	16	-	-	-	-	1	4
Order Ephemeroptera: Mayflies									
Family Beatidae: Baetids	69	84	44	-	11	20	6	12	80
Heptagenidae: Clinging Mayflies	6	-	7	-	-	-	4	1	-
Tricorythidae: Sprawling Mayflies	-	79	7	-	160	7	1	134	14
Leptophlebiidae: Leptophlebids	-	-	19	-	99	2	-	18	-
Ephemerellidae: Clinging Mayflies	-	-	7	-	-	-	-	-	-
Order Trichoptera: Caddis Flies									
Family Hydropsychidae: Seine-making Caddis Flies	38	21	288	10	152	75	1	290	2984
Brachycentridae: Log Cabin Case-Making Caddis Flies	1	2	-	-	-	-	-	-	-

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1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-19 (Cont.) 1/

Taxon	STATION								
	Upper			Middle			Lower		
	July	Aug	Sept	July	Aug	Sept	July	Aug	Sept
Family Hydroptilidae: Purse-making Caddis Flies	-	19	32	-	45	-	-	428	-
Leptoceridae: Leptocerids	-	-	-	-	-	-	-	-	16
Glossosomatidae: Turtle-shell Case Builders	-	-	-	-	11	-	-	4	-
Helicopsychidae: Snail-shell Case Builders	-	-	-	-	-	-	-	3	6
Limnephilidae: Limnephilids	-	-	6	-	-	-	-	-	-
Psychomyiidae: Silken-tube Caddis Flies	-	-	-	-	-	-	-	10	-
Order Plecoptera: Stone Flies									
Family Perlodidae: Perlodids	-	16	20	-	-	-	-	-	-
Nemouridae: Nemourids	-	6	-	-	-	-	-	-	-
Chloroperlidae: Chloroperlids	-	-	10	-	-	-	-	-	-
Pteronareidae: Pteronareids	-	-	14	-	-	-	-	-	-
Order Coleoptera: Water Beetles									
Family Elmidae: Elmids	15	63	233	-	12	9	1	14	58
Dytiscidae: Predaceous Diving Beetles	-	-	-	-	1	-	-	-	-

1/ SOURCE: **Baseline Environmental Report (Dames and Moore 1975).**

TABLE IX-19 (Cont.) [1]

Taxon	STATION Upper July	 Aug	 Sept	 Middle July	 Aug	 Sept	 Lower July	 Aug	 Sept
Family Dryopidae: Dryopids	-	-	1	-	-	-	-	-	2
Order Hemiptera: True Bugs									
Family Corixidae: Water Boatmen	-	1	-	-	-	-	-	24	10
Naucoridae: Creeping Water Bugs	-	-	-	-	6	-	-	-	-
Order Odonata: Dragonflies and Damselflies									
Family Gomphidae: Gomphids	-	-	-	-	-	1	-	1	-
Other Invertebrates									
Phylum Annelida: Aquatic Earthworms									
Class Oligochaeta: Aquatic Earthworms									
Order Plesiopora: Aquatic Earthworms	-	-	24	-	87	104	1	325	88
Phylum Arthropoda: Arthropods									
Class Crustacea: Crustaceans									
Family Talitridae: Water Fleas	-	-	-	-	1	1	-	1	-

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[1] SOURCE: **Baseline Environmental Report (Dames and Moore 1975).**

Aquatic Biology

TABLE IX-19 (Cont.) 1/

Taxon	STATION								
	Upper			Middle			Lower		
	July	Aug	Sept	July	Aug	Sept	July	Aug	Sept
Class Arachnoidea: Spiders and Mites									
Order Hydracarina: Water Mites	-	-	-	-	15	-	-	17	4
Phylum Mollusca: Snails and Clams									
Class Gastropoda: Snails									
Family Physidae: Physids	-	-	-	-	-	3	-	2	20
Ancylidae: Limpets	-	-	-	-	5	-	-	-	-
Sphaeriidae: Sphaerids	-	-	-	-	-	-	-	1	-
Phylum Nematoda: Roundworms	-	-	1	-	-	-	-	-	-

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-20

Numbers and Kinds of Benthic Macroinvertebrates Collected in One Surber Bottom Sample in July, August, and September, 1975 at Each Station, on Trout Creek [1]

	STATION					
	Upper			Lower		
Taxon	July	Aug	Sept	July	Aug	Sept
Class Insecta: Insects						
Order Diptera: True Flies						
Family Tendipedidae: Midges	2	94	55	6	2544	128
Tipulidae: Crane Flies	1	-	-	-	-	17
Simulidae: Black Flies	-	72	3	2	102	2
Heleidae: Biting Midges	-	-	-	2	2	-
Rhagionidae: Snipe Flies	-	1	-	-	-	-
Musidae: Musids	-	-	1	-	-	-
Stratiomyidae: Soldier Flies	-	-	4	-	-	-
Order Ephemeroptera: Mayflies						
Family Baetidae: Baetids	11	54	76	17	186	82
Ephemerellidae: Clinging Mayflies	1	15	2	4	86	10
Tricorythidae: Sprawling Mayflies	-	-	2	19	1710	49
Heptageniidae: Clinging Mayflies	-	1	29	-	-	10

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[1] SOURCE: Baseline Environmental Report (Dames and Moore, 1975).

TABLE IX-20 (Cont.) 1/

Taxon	STATION Upper July	Upper Aug	Upper Sept	Lower July	Lower Aug	Lower Sept
Order Trichoptera: Caddis Flies						
Family Helicopsychidae: Snail-shell Case Builders	5	1	14	-	-	14
Glossosomatidae: Turtle-shell Case Builders	1	55	22	-	6	6
Leptoceridae: Leptocerids	1	-	-	-	-	3
Philopotamidae: Philopotamids	-	10	-	-	-	-
Brachycentridae: Log Cabin Case Builders	-	32	15	-	-	-
Hydropsychidae: Seine-making Caddis Flies	-	68	428	-	68	329
Hydroptilidae: Purse-making Caddis Flies	-	21	4	-	90	4
Hydropsychidae: Seine-making Caddis Flies	-	68	428	-	68	329
Limnephilidae: Limnephilids	-	-	1	-	-	-
Order Plecoptera: Stone Flies						
Family Perlodidae: Perlodids	-	10	16	-	2	18
Nemouridae: Nemourids	-	10	-	-	-	-
Perlidae: Perlids	-	1	1	-	-	-

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-20 (Cont.) 1/

Taxon	STATION					
	Upper			Lower		
	July	Aug	Sept	July	Aug	Sept
Chloroperlidae: Chloroperlids	-	-	-	-	-	1
Order Coleoptera: Water Beetles						
Family Elmidae: Elmids	-	99	100	-	80	25
Other Invertebrates						
Phylum Annelida: Aquatic Earthworms						
Class Oligochaete: Aquatic Earthworms						
Order Plesiopora: Aquatic Earthworms	2	-	-	26	1182	7
Phylum Nematoda: Roundworms	2	2	2	-	-	-
Phylum Mollusca: Snails and Clams						
Class Pelecypoda: Clams						
Family Sphaeriidae: Sphaerids	1	-	-	-	-	1
Class Gastropoda: Snails						
Family Physidae: Physids	2	-	-	-	4	2
Ancylidae: Limpets	-	-	-	-	2	5
Phylum Arthropoda: Arthropods						
Class Arachnoidea: Spiders and Mites						
Order Hydracarina: Water Mites	-	-	-	-	18	2

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-21

Numbers and Kinds of Benthic Macroinvertebrates Collected in One Surber Bottom Sample in July and August, 1975 at Each Station on Foidel Creek 1/

Taxon	STATION			
	Upper		Lower	
	July	Aug	July	Aug
Class Insecta: Insects				
Order Diptera: True Flies				
Family Tendipedidae: Midges	70	587	76	1703
Simulidae: Black Flies	2	-	151	890
Musidae: Musids	-	-	1	3
Heleidae: Biting Midges	-	46	-	50
Order Ephemeroptera: Mayflies				
Family Baetidae: Baetids	-	-	-	2
Order Trichoptera: Caddis Flies				
Family Hydropsychidae: Seine-making Caddis Flies	-	-	-	5
Hydroptilidae: Purse-making Caddis Flies	-	1	-	50
Limnephilidae: Limnephilids	-	4	-	-
Order Coleoptera: Water Beetles				
Family Elmidae: Elmids	4	1	-	7
Haliplidae: Crawling Water Beetles	1	1	-	-

1/ **SOURCE: Baseline Environmental Report (Dames and Moore 1975).**

TABLE IX-21 (Cont.) 1/

Taxon	STATION Upper July	STATION Upper Aug	STATION Lower July	STATION Lower Aug
Family Dytiscidae: Predaceous Diving Beetles	–	1	1	–
Hydrophilidae: Water Scavenger Beetles	–	9	–	1
Order Hemiptera: True Bugs				
Family Corixidae: Water Boatmen	1	–	–	–
Veliidae: Broad-shouldered Water Striders	–	1	–	–
Other Invertebrates				
Phylum Nematoda: Round Worms	–	2	29	48
Phylum Annelida: Aquatic Earthworms				
Class Oligochaeta: Aquatic Earthworms				
Order Plesiopora: Aquatic Earthworms	3	18	225	359
Class Hirudinea: Leeches				
Family Glossiphoniidae	1	3	–	–
Phylum Arthropoda: Arthropods				

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-21 (Cont.) 1/

Taxon	STATION			
	Upper		Lower	
	July	Aug	July	Aug
Class Crustacea: Crustaceans				
Family Talitridae: Water Fleas	8	133	-	23
Gammaridae: Water Fleas	-	199	-	1
Astacidae: Crayfish	-	-	3	-
Subclass Ostracoda: Seed Shrimps				
Order Podocopa: Seed Shrimps	-	6	-	-
Class Arachnoidea: Spiders and Mites				
Order Hydracarina: Water Mites	-	1	-	-
Phylum Mollusca: Snails and Clams				
Class Gastropoda: Snails				
Family Physidae: Physids	-	-	-	13
Lymnaeidae: Lymnaeids	-	-	-	13

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-22

Numbers and Kinds of Benthic Macroinvertebrates Collected in One Surber Bottom Sample in July, August, and September, 1975 at Each Station on Middle Creek 1/

Taxon	STATION					
	Upper			Lower		
	July	Aug	Sept	July	Aug	Sept
Class Insecta: Insects						
Order Diptera: True Flies						
Family Tendipedidae: Midges	36	126	96	19	33	198
Simuliidae: Black Flies	14	-	-	6	-	30
Tipulidae: Crane Flies	-	-	12	1	-	20
Stratiomyidae: Soldier Flies	1	-	-	-	-	-
Heleidae: Biting Midges	-	18	18	1	-	6
Empididae: Empidids	-	1	-	-	-	-
Musidae: Musids	-	1	-	-	-	8
Tabanidae: Horse Flies	-	-	1	-	-	-
Order Ephemeroptera: Mayflies						
Family Baetidae: Baetids	116	-	-	22	18	94
Heptageniidae: Clinging Mayflies	19	-	-	1	-	-
Ephemerellidae: Clinging Mayflies	1	-	-	-	-	-
Leptophlebiidae: Leptophlebiids	-	2	-	-	-	-
Tricorythyidae: Sprawling Mayflies	-	-	-	-	45	36

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

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TABLE IX-22 (Cont.)

Taxon	Upper July	Upper Aug	Upper Sept	Lower July	Lower Aug	Lower Sept
Order Trichoptera: Caddis Flies						
Family Limnephilidae: Limnephilids	1	–	–	3	–	–
Hydroptilidae: Purse-making Caddis Flies	8	–	–	1	–	–
Hydropsychidae: Seine-making Caddis Flies	3	–	1	–	2	30
Brachycentridae: Log Cabin Case-Making Caddis Flies	1	–	–	–	–	–
Psychomyiidae: Silken-tube Caddis Flies	1	–	–	–	–	–
Limnephilidae: Limnephilids	–	–	–	–	1	2
Order Plecoptera: Stone Flies						
Family Nemouridae: Nemourids	6	–	–	–	–	–
Order Coleoptera: Water Beetles						
Family Elmidae: Elmids	13	–	1	9	27	84
Dytiscidae: Predaceous Diving Beetles	1	2	–	–	2	–
Hydrophilidae: Water Scavenger Beetles	–	–	–	–	–	8

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[1] SOURCE: **Baseline Environmental Report (Dames and Moore 1975).**

TABLE IX-22 (Cont.)

Taxon	STATION					
	Upper			Lower		
	July	Aug	Sept	July	Aug	Sept
Order Hemiptera: True Bugs						
Family Veliidae: Broad-shouldered Water Striders	-	-	-	-	-	2
Corixidae: Water Boatmen	-	-	-	-	-	2
Other Invertebrates						
Phylum Nematoda: Roundworms	1	3	-	2	-	-
Phylum Annelida: Aquatic Earthworms						
Class Oligochaeta: Aquatic Earthworms						
Order Plesiopora: Aquatic Earthworms	6	677	163	62	5	70
Class Hirudinea: Leeches						
Family Glossiphonidae: Glossiphonids	-	-	-	2	-	4
Phylum Arthropoda: Arthropods						
Class Crustacea: Crustaceans						
Family Talitridae: Water Fleas	1	1	-	-	5	14
Gammaridae: Water Fleas	-	-	-	-	-	10
Subclass Ostracoda: Seed Shrimps						

1/ SOURCE: Baseline Environmental Report (Dames and Moore 1975).

TABLE IX-22 (Cont.)

Taxon	STATION					
	Upper			Lower		
	July	Aug	Sept	July	Aug	Sept
Order Podocopa: Seed Shrimps	-	-	2	-	-	-
Class Arachnoidea: Spiders and Mites						
Order Hydracarina: Water Mites	-	-	-	-	-	4
Phylum Mollusca: Snails and Clams						
Class Pelecypoda: Clams						
Family Sphaeriidae: Sphaerids	-	-	-	1	-	6
Class Gastropoda: Snails						
Family Physidae: Physids	1	1	-	-	13	40
Lymnaeidae: Lymnaeids	-	-	-	-	-	4

1/ **SOURCE: Baseline Environmental Report (Dames and Moore 1975).**

Aesthetics and Recreation

APPENDIX D

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Aesthetics and Recreation

TABLE X-1

Coliform Stream Sampling Results

Stream	Type of Measure	Parameters* Total Coliform	Parameters* Fecal Coliform
White River at Rangely (Class B$_2$)	Mean	4474.53[1]	689.2[1] 346.3[2]
	Maximum	33000.0[1]	4900.0[1] 2200.0[2]
	Minimum	96.0[1]	5.0[1] 2.2[2]
White River, below Piceance Creek (Class B^2)	Mean	2768.0[1]	2503.3[2]
	Maximum	22000.0[1]	22000.0[2]
	Minimum	30.0[1]	5.0[2]
White River at Meeker (Class B^1)	Mean	-	-
	Maximum	-	-
	Minimum	-	-
Yampa River, below Little Snake River (Class B^2)	Mean	745.0[1]	117.7[1] 22.7[2]
	Maximum	7900.0[1]	790.0[1] 38.0[2]
	Minimum	5.0[1]	2.0[1] 8.0[2]
Yampa River, near Maybell (Class B^2)	Mean	756.1[1]	112.1[1] 240.0[2]
	Maximum	4900.0[1]	1300.0[1] 240.0[2]
	Minimum	2.2[1]	2.0[1] 240.0[2]

* per 100 ml.

SOURCE: STORET, Environmental Protection Agency, 1974.

TABLE X-1 (Cont.)

Coliform Stream Sampling Results

Stream	Type of Measure	Parameters* Total Coliform	Fecal Coliform
Yampa River at Milner (Class B_1)	Mean	2498.2[1]	865.3[1] 244.4[2]
	Maximum	23000.0[1]	22000.0[1] 500.0[2]
	Minimum	15.0[1]	2.0[1] 2.2[2]
Yampa River, above Oak Creek confluence (Class B_1)	Mean	1949.0[1]	75.5[2]
	Maximum	30000.0[1]	300.0[2]
	Minimum	2.2[1]	2.2[2]
Little Snake River, above Lily Park (Class B_1)	Mean	2680.6[1]	255.2[1] 129.0[2]
	Maximum	30000.0[1]	3000.0[1] 200.0[2]
	Minimum	15.0[1]	2.0[1] 38.0[2]

1. Compiled from lab tests that confirm the Most Probable Number (MPN) through a determination of the presence of Colifrom bacteria. This is the state standard method for Colorado. (SOURCE: 1974 - Green River Basin Water Quality Mgmt. Plan).

2. Compiled from lab tests using the Media Filter Method (MFM) wherein an actual count of coliform groups is made. This is the most accurate and reliable method.

* per 100 ml.

SOURCE: STORET, Environmental Protection Agency, 1974.

TABLE X-2

U.S. Forest Service Recreation Developments

Name	Camp Units	Picnic Units	Drinking Water	Boat Ramp	Small Trailer
Freeman Campground (C.G.)	12	--	--	--	X
Sawmill C.G.	5	1	X	--	X
Hahns Peak Lake C.G.	26	--	X	X	X
Hinman C.G.	13	--	X	--	X
Box Canyon C.G.	11	--	--	--	X
Seedhouse C.G.	24	6	X	--	X
Summit Lake C.G.	9	8	X	--	X
Granite C.G.	6	--	--	X	--
Dry Lake C.G.	8	--	X	--	X
Ferndale Picnic ground(P.G.)	--	9	X	--	--
Harrison Creek P.G.	--	4	X	--	--
Meadows C.G.	32	--	X	--	X
Walton Creek C.G.	14	--	X	--	X
Dumont Lake C.G.	12	11	X	--	X
Lynx Pass C.G.	12	--	X	--	X
Toponas Creek C.G.	5	--	X	--	X
Stillwater C.G.	9	4	X	--	X
Horseshoe C.G.	6	--	X	--	X
Cold Springs C.G.	5	--	X	--	X
Vaughn Lake C.G.	8	--	--	--	X
North Fork C.G.	47	--	X	--	X
Marvine C.G.	16	--	(Stream)	--	X
Himes Peak C.G.	8	--	(Stream)	--	X
Trappers Lake C.G.	51	--	X	--	X
Hill Creek C.G.	10	--	(Stream)	--	X
South Fork C.G.	17	--	(River)	--	X
East Marvine C.G.	7	--	(Stream)	--	X

SOURCE: U.S. Forest Service, RIM Directory -- Information for National Forests.

TABLE X-3

Dinosaur National Monument Recreation Sites in Colorado

Name	Activity-Facility
Gates of Lodore Campground (C. G.)	17 units; tables, trailer sites and water. One boat ramp. Ranger station.
Deerlodge Park C.G.	8 units; tables and toilets. Water in summer. One boat ramp.
Echo Park C.G.	20 units; tables and water. One boat ramp. Seasonal ranger station.
Primitive River Camps	4 on Green River (in Colo.) and 5 on Yampa River.
Plug Hat Picnic ground (P.G.)	10 tables, limited water.
Echo Park P.G.	5 tables.
Canyon P.G.	8 tables.
Dinosaur Headquarters & Visitor Center	Auditorium and display room.

SOURCE: Dinosaur National Monument, facilities (unpublished) 1975.

TABLE X-4

Colorado Division of Wildlife Recreation Developments

Name	Acres	Activity-Facility
Service Creek C.G.	311	River fishing, horseback riding, hiking (foot trail), camping, and picnicking.
Indian Run C.G.	2,044	River fishing and tubing, camping, picnicking, horseback riding, hiking, and four-wheel driving.
Bel Air Rearing Station	178	Viewing trout rearing ponds and tent camping (4 sites).
Cristina Picnic ground	-	Picnicking and river fishing.
Cold Springs Primitive Hunter Camps (DOW - BLM cooperative)	-	Open space camping and picnicking on national resource lands (NRL), hunting, and horseback riding. Includes camps at No Name Spring, Bishop Spring, Rocky Reservoir, Pines, Calloway, and Wiggins.
Ralph White Reservoir	299	Open space camping and picnicking, boating (one ramp), water-skiing, and fishing.
Rio Blanco Lake	383	Boating (one ramp), water-skiing, fishing and waterfowl hunting. Facilities include one trailer camping site and 16 picnic sites.
Lake Avery	2,172	Boating (one ramp), water-skiing, fishing and bird-watching. Facilities include 25 picnicking sites plus open-space camping and picnicking. No water; sewer dump station.
White River Public Fishing Easements (4)	est. 3 1/2 mi.	Two lie immediately below Meeker and two lie east of Meeker between town and Lake Avery.
Elk River Fishing Easement	2 1/2 mi.	From Mad Creek Canyon downstream to Elk River bridge.

SOURCES: Colorado Division of Parks, 1974 Interim Comprehensive Outdoor Recreation Plan.
Bureau of Land Management, Craig District Office, 1975.

TABLE X-5

Municipal, County and Quasi-Public Recreation Facilities

Location	Acreage	Activity-Facility
Steamboat Springs City Park	8	Playgrounds, open space, picnicking (8 sites), and fishing.
Steamboat Springs Municipal Pool	0.25	Swimming (indoor and outdoor) and 2 tennis courts.
Riverbend Golf Course	40	Nine holes, 40 acres.
Steamboat Schools (2 sites)	2 & 5	Playgrounds. Playgrounds and 2 tennis courts.
Hayden Schools	5	Playgrounds.
Steamboat Springs County Park	5	Playgrounds, open space, and horseback riding.
Howelson Hill, Steamboat Springs Winter Sports Club	-	Ski jumping, 3 jumps (15, 30 and 60 meter). Baseball diamond, soccer and rugby field, rodeo arena, and ice rink.
Yampa Valley Golf Association (Craig)	120	Nine hole golf course.
Craig City Park	4	Playgrounds, tennis (3 cts.), camping, picnicking (12 sites), basketball (1 ct.), swimming pool, and ice skating rink.
Maybell City Park	2	Playground, trailer camping (18 sites), and picnicking (18 sites).

TABLE X-5 (Cont.)

Location	Acreage	Activity-Facility
Craig schools (4 sites)	4	Playgrounds.
	4	Playgrounds.
	4	Playgrounds.
	25	Playgrounds.
Hamilton schools	1	Playgrounds.
Maybell schools	3	Playgrounds.
Lay schools	10	Playgrounds.
Powder Wash schools	0.25	Playgrounds.
Browns Park Schools	0.5	Playgrounds.
Dinosaur schools	3	Playgrounds.
Rangely City Park	5	Playgrounds and swimming pool.
Slush Pit Golf Course	30	Nine hole golf course at Chevron oil camp.
Rangely Schools (3 sites)	2	Playgrounds.
	5.2	Playgrounds.
	10	Playgrounds.
Rangely College	10	Playground for field games.
Meeker City Park	5	Playground, camping, fishing, river tubing, ice skating, and swimming pool.
Meeker Golf Course	20	Nine hole golf course.

TABLE X-5 (Cont.)

Location	Acreage	Activity-Facility
White River Recreation Area	-	Picnicking and camping, tables, sewer dump station.
Meeker schools (3 sites)	1.5	Playgrounds.
	3	Playgrounds and 2 tennis courts.
	14	Playgrounds.

SOURCES: Colorado Division of Parks, 1974 Interim Comprehensive Outdoor Recreation Plan.
Bureau of Land Management, Craig District office, White River URA-MFP, 1975.

TABLE X-6

Private Recreation Facilities (SCS, 1974)

Name	No.	Activity-Facility
In Moffat County:		
KOA Campground east of Craig	1	Transient camping, 6 acres, 57 vehicle sites, and 12 tent sites.
Carl Walgreen	2	Transient camping, 150 acres, 35 vehicle sites, and 25 tent sites.
Craig Gun Club	3	Shooting range, 5 positions.
Milliken Land and Cattle Co.	4	Fishing, 1 lake, 13 acres.
Ton Grieves	5	Fishing, 2 lakes, 10 acres.
Don Seick	6	Fishing, 1 lake, one acre.
Craig Stock Car Assoc.	7	Racetrack, 5 acres, 600 spectators.
Mrs. Stell Craig Juniper Hot Springs	8	Recreation resort, 20 acres, 40 guests. Swimming pool, 1875 sq.ft. Day camping, 2 acres, 15 guests.
Maybell Roping Arena	9	One acre.
Deer Creek Roping Arena	10	Two acres.
Cathy Cisar Association	11	Beginners -- youth ski area, rope tow, four acres, 275 skiers/hr. lift capacity.
Three Springs Ranch	12	Big game hunting, 12,000 acres.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Tom Blevins	13	Big game hunting, 160 acres.
Albert Camilletti	14	Big game hunting, 1440 acres.
Ed Clark	15	Big game hunting, 1240 acres.
Durham Livestock	16	Big game hunting, 5922 acres.
Lorence Ellgen	17	Big game hunting, 1936 acres.
Leon Fedinec	18	Big game hunting, 2940 acres.
Greg Hilton	19	Big game hunting, 6370 acres.
Boy Lyons	20	Big game hunting, 1200 acres.
Tim Mantle	21	Big game hunting, 1800 acres.
Sam McIntyre	22	Big game hunting, 1080 acres.
Ken Osborn	23	Big game hunting, 714 acres.
Bruce Seely	24	Big game hunting, 18,760 acres.
David Seely	25	Big game hunting, 18,056 acres.
Dan Sherman	26	Big game hunting, 6,582 acres.
Bob Simpson	27	Big game hunting, 200 acres.
Darryl Steele	28	Big game hunting, 280 acres.
Boyd Walker	29	Big game hunting, 5,320 acres.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Gilbert Williams	30	Big game hunting, 1,607 acres.
Paul Zingheim	31	Big game hunting, 1,080 acres.
Mary Sullivan	32	Big game hunting, 400 acres.
Wes Raley	33	Big game hunting, 3,360 acres.
Martin Bros.	34	Big game hunting, 5,000 acres.
In Routt County:		
Frances Marsh	35	Big game hunting, 2,700 acres.
Focus Ranch	36	Dude ranch, 30 guest. Horseback riding, 25 miles trails, 30 horse rentals. Hunting, 577 acres.
Donald Ely	37	Big game hunting, 1,219 acres.
Hahns Peak	38	Historical site, 40 acres.
Boot Jack Ranch, Glen Johnson	39	Big game hunting, 443 acres.
Columbine Ski Area	40	Lift capacity 2,100 persons/hr., 200 acres, 700 skiers/day and 2 double chair lifts. (Not operating during 1974 and 1975 season).
Circle 4 Ranch	41	Big game hunting, 5 acres.
Triangle Three	42	Big game hunting, 280 acres. Dude ranch, 6 guest. Horseback riding, 10 miles trails, 6 rentals.
Elk River Guest Ranch	43	Dude ranch, 80 acres, 20 guest. Horseback riding, 20 mile trails. Picnicking, 2 acres, 3 tables. Vacation camping, 2 acres and 3 vehicle sites.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Vista Verde	44	Dude ranch, 6 guests. Big game hunting, 885 acres.
Dean Chew	45	Big game hunting, 3,700 acres.
Elk River Recreation	46	Dude ranch, 10 acres.
Elk River Grazing Assoc.	47	Big game hunting, 5,730 acres.
Big Creek Reserve	48	Dude ranch, 10 guests. Big game hunting, 895 acres. Fishing, 3 acres, 2 ponds. Shooting stocked game, 1 acre. Trails, 4 miles.
S-S Ranch	49	Dude ranch, 10 guests. Big game hunting, 2,767 acres.
William Hellyer	50	Big game hunting, 147 acres.
Ski Town KOA Campground	51	Transient camping, 18 acres, 75 vehicle sites and 18 tent sites.
Ray Bunn	52	Big game hunting, 1,300 acres.
Gary A. Kihlstrom	53	Big game hunting, 5 acres. Horseback riding, 20 miles trails 10 rentals.
Steamboat Health and Recreation Association	54	Swimming pool, 7,000 sq. ft. 2 tennis courts.
Fish Creek Falls	55	Picnicking, 6 tables. Bicycling trails, 3 miles.
Fish Creek Park LTD	56	Transient camping 10 acres, 16 vehicle sites, and 16 tent sites.
Steamboat Ski Area, Steamboat Village Resort	57	Snow skiing, 3,500 acres, 6,000 skier/hr. lift capacity. Tennis, 8 courts. Regulation golf course, 170 acres, 18 holes. Horseback riding, 60 miles trails, 40 rentals. Snowmobiling, 200 acres, 20 miles trails.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Storm Meadows	58	Recreation resort, 20 acres, 200 guests. Three tennis courts. Swimming pool, 5,000 sq. ft.
Scandinavian Lodge	59	Recreation resort, 16 acres, 40 guests. Two tennis courts.
Green Acres	60	Big game hunting, 2,170 acres.
The Timbers	61	Recreation resort, 466 acres, 100 guests. Ten tennis courts. Fishing, 1 pond, 1 acre. Horseback riding, 3 miles trails, 15 rentals. Swimming pool, 5,000 sq. ft.
Louis Wyman	62	Shooting stocked game, 2,000 acres.
Robert Gay	63	Big game hunting, 1,729 acres.
Bruce Henderson	64	Big game hunting, 2,000 acres.
Oak Creek Rodeo and Recreation Junction	65	Rodeo grounds, 5 acres.
Dan Knott	66	Big game hunting, 4,673 acres.
Stagecoach Ski Area	67	Snow skiing, 5,000 skiers/hr., 3,500 acres. Four tennis courts. Fishing, 2 acres, 1 lake. Horseback riding, 60 miles trails, 40 rentals. Snowmobiling, 200 acres, 20 miles trails. (Not operating during 1974 and 1975 season).
R. H. Mile	68	Big game hunting, 1,520 acres.
Eagle Rock Lake	69	Dude ranch, 290 acres, 25 guests. Fishing ponds, 50 acres, 4 ponds. Big game hunting, 290 acres. Non-motorized boating, 5 rentals. Hiking trails, 2 miles.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Mt. Elim Bible Camp	70	Day camping, 40 acres, 80 guests. Picnicking, 10 acres, 3 tables.
Clyncks Ranch	71	Dude ranch, 1,087 acres, 5 guests. Vacation camping, 2 acres, 2 vehicle sites. Picnicking, 2 acres, 2 tables. Horseback riding, 5 miles trails, 5 rentals.
Flattop Wilderness Ranch	72	Dude ranch, 581 acres, 40 guests. Vacation camping, 6 acres, 12 vehicle sites, 5 tent sites.
Egeria Roping Club	73	Rodeo grounds, 5 acres.
Kelly Klumker	74	Fishing ponds, 5 acres, 1 lake. Big game hunting, 2,500 acres.
In Rio Blanco County:		
Harry Jorden	75	Big game hunting, 5,580 acres. Recreation resort, 10 guests. Pack-in camping, 1 acre. Horseback riding, 10 mile trails, 10 rentals.
Sizemore's Resort	76	Big game hunting, 160 acres. Recreation resort, 20 guests. Pack-in camping, 4 areas. Horseback riding, 1 mile trails, 25 rentals, 10 horses boarded.
Windy Bill Ranch	77	Big game hunting, 80 acres. Recreation resort, 10 guests. Snowmobiling, 80 acres. Fishing, 5 acres, 3 ponds.
Buford Lodge	78	Big game hunting, 220 acres. Archery, 1 range. Picknicking, 10 acres, 8 tables. Recreation resort, 20 guests. Horseback riding, 1 mile trails, 10 guests. ORV trails, 2 miles. Vacation camping, 5 vehicle sites. Fishing, 10 acres, 1 pond. Pack-in camping, 2 areas.
Elwood Livingston	79	Big game hunting, 1,255 acres. ORV trails, 3 miles. Recreation resort, 9 guests. Fishing, 6 acres, 5 ponds.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
White River Ranch	80	Big game hunting, 4,244 acres. Recreation resort. 15 guests.
Sleepy Cat Guest Ranch	81	Big game hunting, 140 acres. Horseback riding, 3 miles trails, 8 rentals. Snowmobiling and ORVs, 1 mile trails. Pack-in camping, 2 areas.
Nick Mahlares	82	Big game hunting, 4,001 acres. ORV trails, 10 miles.
Dean Chambers	83	Big game hunting, 14 acres. Recreation resort, 14 guests. Pack-in camping, 3 areas. Fishing, 3 acres, 1 pond.
Roy Thompson	84	Big game hunting, 1,348 acres. Recreation resort, 8 guests. ORVs, 10 miles trails.
Robert Dearman	85	Big game hunting, 57 acres. Recreation resort, 40 guests. Fishing, 1 acres, 1 pond. Snowmobiling, 1 mile trails.
Buckhorn Guest Ranch	86	Big game hunting, 10 acres. Recreation resort, 12 guests. Pack-in camping, 3 areas. ORVs, 10 miles trails. Fishing, 10 acres, 1 pond.
Adams Lodge	87	Big game hunting, 160 acres. Recreation resort, 30 guests. Fishing, 4 acres, 2 ponds. Pack-in camping, 2 areas. Horseback riding, 1 mile trails, 30 rentals.
Lee Watson	88	Big game hunting, 6,962 acres. Recreation resort, 15 guests. ORVs, 8 miles trails.
Delbert Pollard	89	Big game hunting, 3,200 acres. ORVs, 5 mile trails.
Evenson Ranch	90	Big game hunting, 120 acres. Recreation resort, 20 guests. Dude ranch, 10 guests.
Welle Guest Ranch	91	Transient camping, 15 acres, 6 vehicle sites. Vacation camping, 3 vehicle sites. Recreation resort, 27 guests.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Elry Kincher	92	Big game hunting, 2,043 acres. Recreation resort, 20 guests. ORVs, 5 miles trails.
Jim Steele	93	Big game hunting, 2,500 acres. Recreation resort, 10 guests. ORVs, 4 miles trails.
Russell Cabins	94	Recreation resort, 5 acres, 20 guests.
Jack Russell	95	Big game hunting, 4,661 acres. Recreation resort, 12 guests. ORVs, 7 miles trails.
Nick Theos	96	Big game hunting, 10,087 acres. ORVs, 21 miles trails. Fishing, 4 acres, 1 pond.
Mike Theos	97	Big game hunting, 3,608 acres. ORVs, 7 miles trails.
Dean Parr	98	Big game hunting, 1,062 acres. ORVs, 3 miles trails.
Sombrero Ranch	99	Big game hunting, 1,100 acres. Pack-in camping, 4 areas. Trails, 4 miles (2 ORV).
John Jump	100	Big game hunting, 220 acres. ORVs, 2 miles trails.
Elmer Mack	101	Big game hunting, 640 acres.
Gus Charchalis	102	Big game hunting, 1,920 acres. Horseback riding, 2 miles trails 4 rentals. Recreation resort, 5 guests.
Doug Wellman	103	Big game hunting, 3,380 acres. Recreation resort. 10 guests.
Lewis Livingston	104	Big game hunting, 6,645 acres. Fishing, one acre, one pond. ORVs, 8 miles trails.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Bert Rosenlund	105	Big game hunting, 2,627 acres. Pack-in camping, 4 areas. ORVs, 2 miles trails.
Pat Sullivan	106	Big game hunting, 1,080 acres. Recreation resort, 12 guests. Fishing, 2 acres, 3 ponds. ORVs, 2 miles trails.
Robert Wells	107	Big game hunting, 5,000 acres. Recreation resort, 30 guests. ORVs, 8 miles trails.
Jim Dodo	108	Big game hunting, 6,536 acres. ORVs, 6 miles trails.
Stagecoach Park	109	Transient and vacation camping, 27 acres plus 16 vehicle and 6 tent sites for each type. Fishing, 5 acres, 2 ponds. Picnicking, 6 tables. Boating, 2 rentals.
Rimrock Gunshop & Campground	110	Transient camping, 2 acres, 15 vehicle sites. Vacation camping, 5 vehicle sites. Picnicking, 4 tables. Shooting range, 20 positions.
Pete Ottoson	111	Big game hunting, 4,068 acres. Recreation resort, 22 guests. ORVs, 15 miles trails.
Bob Peters Ranch	112	Big game hunting, 1,529 acres. Recreation resort, 12 guests. ORVs, 3 miles trails.
Ute Lodge	113	Big game hunting, 312 acres. Recreation resort, 20 guests. Hiking trails, 5 miles. Horseback riding, 2 miles trails, 30 rentals. Pack-in camping, 2 areas. Archery range, 1 position.
Bob Crawford	114	Big game hunting, 4,647 acres. ORVs, 4 miles trails.
Eloise Bailey	115	Big game hunting, 4,712 acres. Recreation resort, 40 guests. ORVs, 7 miles trails.

TABLE X-6 (Cont.)

Name	No.	Activity-Facility
Red Thomas	116	Big game hunting, 7,389 acres. Recreation resort, 45 guests. ORVs, 11 miles trails.
Roy McKee	117	Big game hunting, 640 acres. Recreation resort, 5 guests. Horseback riding, 2 miles trails, 5 rentals.
Don Ward	118	Big game hunting, 6,000 acres. Recreation resort, 25 guests. ORVs, 5 miles trails.
K/K Ranch	119	Big game hunting, 13,747 acres. Recreation resort, 10 guests. Fishing, 4 acres, 1 pond. ORVs, 14 miles trails.
B.P.O.E. - Gun Club	120	Shooting range, 20 positions.
White River Bowmen Club	121	Archery Range, 20 positions.

SOURCE: U.S. Soil Conservation Service; NACD Inventory of Private Recreation Facilities, Steamboat Springs, Craig and Meeker, 1974.

TABLE X-7

Sportmans's Club Leases

Name	Leaseholder	Acreage	Activity-Facility
Martin Bros.	ASC[1]	5,000	Antelope hunting.
Buck Mtn. and the Chow Ranch	ASC	5,000	Elk and deer hunting. Camping and bow hunting.
Elk River	ASC	3,700	Excellent fly fishing. Deer and elk hunting plus bow hunting.
Yampa River	ASC	--	Good fishing and camping.
Blacktail	ASC	--	Deer and elk hunting. Camping.
Winslett - Zingheim	ASC	--	Deer and elk hunting. Camping.
Moffat Co. Unit 'A'	ISC[2]	--	Excellent antelope hunting. Deer and sage grouse hunting.
Moffat Co. Unit 'B'	ISC	--	Excellent antelope hunting. Deer, coyote, and sage grouse hunting.
Toponas	ISC	--	Deer and elk hunting. Bear and mountain lion in the area. Two base camps.

1/ American Sportsman's Club
2/ International Sportsman's Club

SOURCES: American Sportsman's Club 1975.
International Sportsman's Club 1975.
Bureau of Land Management, Craig District Office, Williams Fork URA-MFP 1974.

TABLE X-8

Routt National Forest Recreation-Use by Kinds of Sites

Kind of Site	1974 Visitor Days	1974 % of Total	1969 Visitor Days	1969 % of Total	Average Annual % of Change
General undeveloped areas	176,500	27.1	95,700	27.9	+ 13.02
Roads recreation	130,800	20.1	31,800	9.3	+ 32.69
Winter sports sites	128,400	19.7	50,000	14.6	+ 20.76
Campgrounds	103,200	15.9	80,100	23.3	+ 5.20
Trails recreation	37,500	5.8	23,000	6.7	+ 10.27
Rivers - streams	23,500	3.6	17,700	5.2	+ 5.83
Lakes - ponds	19,300	3.0	19,700	5.7	- 0.41
Reservoirs - impoundments	18,400	2.8	8,600	2.5	+ 16.43
Recreation residence sites	5,700	0.9	5,300	1.5	+ 1.47
Picnic grounds	3,600	0.6	6,500	1.9	- 11.15
Organization sites (pvt)	1,600	0.2	1,600	0.5	+ 0.00
Observation sites	1,500	0.2	3,100	0.9	- 13.51
Boating sites	1,000	0.2	500	0.1	+ 14.87
Total	651,000	100.0	343,600	99.3	+ 13.63

* Compounded annually

SOURCE: Routt National Forest, Recreation Information Management System, 1969 and 1974.

TABLE X-9

White River National Forest Recreation-Use by Kinds of Sites (Blanco Ranger District Only)

Kind of Site	1974 Visitor Days	% of Total	1969 Visitor Days	% of Total	Average Annual % of Change*
General undeveloped areas	118,500	48.2	110,200	48.2	+ 1.46
Roads recreation	41,400	16.8	38,800	16.9	+ 1.31
Campgrounds	33,200	13.5	24.700	10.8	+ 6.09
Lakes - ponds	24,100	9.8	21,100	9.2	+ 2.69
Trails recreation	12,000	4.9	9,100	3.9	+ 5.69
Rivers - streams	6,500	2.6	6,000	2.6	+ 1.61
Rec. residence sites	4,800	2.0	4,900	2.1	- 0.41
Hotel, lodge, resort (pvt.)	4,500	1.8	12,400	5.4	- 18.35
Reservoirs - impoundments	1,100	0.4	1,300	0.5	- 3.29
Total	246,100	100.0	228,500	99.9	+ 1.50

* Compounded annually

SOURCE: White River National Forest, Recreation Information Management System, 1969 and 1974.

TABLE X-10

Dinosaur National Monument Public Use Statistics

Location	Visitors 1973	Visitors 1969	% Average Annual Increase: 1969-1973[1]
Quarry Entrance Rd. (Utah)	279,730	226,028	+ 5.46
Harpers Corner Rd.	39,591	46,058	- 3.71
Headquarters Bldg.	49,325	47,012	+ 1.21
Elk Springs Rd.	1,780	1,401	+ 6.17
Deerlodge Rd.	7,847	2,124	+ 38.64
Lodore	5,884	2,841	+ 19.96
Island Park	7,613	6,588	+ 3.68
Private Boats	3,874	2,548	+ 11.04
Concession Boats	12,614	3,192	+ 40.99
Organized Groups	4,465	---	---
Total Visitors	412,723	337,792	+ 5.14
Total Visitor Days	142,821[2]	103,914	

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[1] Compounded annually

[2] Assuming a 12-hr. visitor-day

SOURCE: Dinosaur National Monument, unpublished public use statistics, 1969-1973.

TABLE X-11

1973 Small Game - Waterfowl Hunting Pressure

	Routt				Moffat				Rio Blanco				Species Totals	
	No. Hunters	% of Total*	No. Days	% of Total*	No. Hunters	% of Total*	No. Days	% of Total*	No. Hunters	% of Total*	No. Days	% of Total*	No. Hunters	No. Days
Duck	179	3.8	--	--	171	1.5	--	--	71	1.5	--	--	421	--
Goose	--	--	--	--	121	15.3	--	--	--	--	--	--	121	--
Dove	158	0.5	615	0.4	95	0.3	308	0.2	63	0.2	308	0.2	316	1,231
Pheasant	--	--	--	--	--	--	--	--	51	0.1	140	0.1	51	140
Bobwhite Quail	--	-	--	--	--	--	--	--	43	1.2	40	0.4	43	40
Sage Grouse	557	11.9	1,106	10.8	1,260	26.9	2,406	23.5	112	2.4	235	2.3	1,929	3,747
Blue Grouse	859	8.2	3,301	12.0	31	0.3	83	0.3	283	2.7	715	2.6	1,173	4,099
Cottontail Rabbit	153	0.4	472	0.2	841	2.2	1,887	0.8	803	2.1	5,660	2.4	1,799	8,019
Snowshoe Hare	224	3.4	667	1.8	73	1.1	113	0.3	224	3.4	1,879	5.0	521	2,669
Snipe	41	11.1	74	5.7	--	--	--	--	41	11.1	740	57.1	82	814
Coyote	--	--	--	--	115	0.7	336	0.2	296	1.8	25,188	15.0	411	25,524
County Totals	2,171		6,245		2,707		5,133		1,987		34,905			

* % of total for State of Colorado.

SOURCE: Colorado Division of Wildlife, 1973 Small Game Harvest Report.

Aesthetics and Recreation

TABLE X-12

Big Game Hunting Pressure - 1973

Species and Type of Hunt	Measuring Parameters	Game Management Unit														
		1	2	3	4	5	10	11	12	13	14	15	23	24	26	441
Deer, Regular Season	No. hunters:	434	2,285	4,842	2,610	1,152	1,079	5,313	1,181	2,006	1,143	1,361	2,059	551	725	529
	Resident	171	861	2,936	1,679	845	565	2,741	765	1,426	866	1,131	1,249	397	583	430
	Non-Resident	263	1,424	1,906	931	307	514	2,572	416	580	277	230	810	154	142	99
	Hunters/mi.^{2}	3.71	1.66	3.59	5.30	3.72	1.30	6.21	2.64	2.61	2.06	2.81	4.65	1.18	3.22	2.35
	Hunter-days*	1,493	9,541	15,336	8,274	3,673	3,715	17,474	3,947	7,211	3,877	4,626	8,084	2,666	2,724	1,350
Deer, Archery	No. hunters:	6	61	91	157	144	43	112	105	260	279	143	239	92	48	44
	Resident	-	29	72	109	118	17	55	66	213	215	127	115	63	41	31
	Non-Resident	6	32	19	48	26	26	57	39	47	64	16	124	29	7	13
	Hunters/mi.^{2}	.05	.04	.07	.32	.46	.05	.13	.23	.34	.50	.30	.54	.20	.21	.20
	Hunter-days	39	252	508	879	744	263	542	657	1,504	1,271	711	1,405	403	205	242
Elk, Regular Season	No. hunters:		291		1,658	1,101		567	1,981	3,660	2,153	1,584	2,330	1,036	827	312
	Resident		250		1,112	884		288	1,383	2,700	1,762	1,369	1,565	838	669	248
	Non-Resident		41		536	217		279	598	960	391	215	765	198	158	64
	Hunters/mi.^{2}		1.37		3.37	3.55		0.66	4.42	4.75	3.88	3.27	5.26	2.21	3.68	1.39
	Hunter-days*		1,055		6,832	4,715		2,197	8,549	17,451	9,748	7,528	13,217	5,433	4,248	1,058
Elk, Archery	No. hunters:		2	3	161	61		78	91	193	112	79	151	110	64	17
	Resident		2	-	69	33		33	63	158	46	67	50	66	45	14
	Non-Resident		-	3	92	28		45	28	35	66	12	101	44	19	3
	Hunters/mi.^{2}		0.00	0.00	0.33	0.20		0.09	0.20	0.25	0.20	0.16	0.34	0.24	0.28	0.08
	Hunter-days		6	18	1,008	404		520	536	1,210	605	388	1,000	628	359	58
Bear	* Hunter-days	123	24		82	67	20	60	207	197	169	94	313	27	20	
Antelope	** No. hunters	26	168	740	17	240										
	Resident	23	161	726	17	230										
	Non-Resident	3	7	14	-	10										
	Hunter-days	40	219	962	26	281										

* This data compiled by big game management units, (see Figure RIV-30).

** This data compiled by antelope game management units, (see Figure RIV-31).

SOURCE: Colorado Division of Wildlife, 1973, Big Game Harvest Report.

TABLE X-13

Big Game Hunter Residence - 1973
Resident Deer Hunters

Planning Region	Game Management Unit															
	1	2	3	4	5	10	11	12	13	14	15	23	24	26	441	Total
1	8	0	35	9	8	0	17	0	17	34	17	0	9	0	18	172
2	8	42	177	143	101	33	169	59	92	41	42	109	42	25	41	1,124
3	50	396	1,602	1,065	576	152	1,537	368	574	423	726	684	220	364	220	8,957
4	9	25	92	42	59	42	203	67	50	42	59	85	25	42	26	868
5	0	0	8	16	0	0	8	0	8	9	8	16	8	0	0	81
6	0	9	17	0	0	0	25	0	0	0	0	0	0	0	0	51
7	0	0	0	0	0	9	34	8	9	0	8	0	0	8	0	76
8	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	25
9	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	17
10	0	0	26	8	24	8	25	0	17	0	0	9	0	8	8	133
11	85	321	852	346	35	304	505	80	270	50	25	319	59	17	0	3,368
12	0	59	110	42	42	17	68	26	380	253	237	9	34	119	117	1,513
13	0	9	17	8	0	0	34	0	9	0	9	18	0	0	0	104
Other	11	0	0	0	0	0	91	40	0	14	0	0	0	0	0	156
Total	171	861	2,936	1,679	845	565	2,741	756	1,426	866	1,131	1,249	397	583	430	16,645

TABLE X-14

Big Game Hunter Residence - 1973
Non-Resident Deer Hunters

	Game Management Unit														
State	1	2	3	4	5	10	11	12	13	14	15	23	24	26	441	Total
Alabama	11		11	11									11			44
Arizona			11				11	11	11			33				77
Arkansas	22	11	33				33	11	33	11	11				11	176
California	22	482	613	225	33	295	735	87	98	88	33	230	45		23	3,009
Delaware		11														11
Florida	22	10	22	11	11	22	32		11			11				152
Georgia					11				11							22
Illinois	11	77	77	44	11		110		22		11	22		11	11	407
Indiana		22	55	11	10	22	88	11	11	43		21			10	304
Iowa	11	11	43				33									98
Kansas			11	22			120	22	11		11			11		208
Kentucky		11	33							11	22	11		11		99
Louisiana	11	44	22				33	11				11	11			143
Maine			11													11
Maryland		11	11	11									11			44
Massachusetts			22													22
Michigan	22	65	142	128	44	11	208	110	44	22		88	10			894
Minnesota		22	55				44	11								132
Mississippi		11	22	55	22		22									132
Missouri	10	88	77	55	22	11	142		33			66	22	11	11	548
Montana			22													22

TABLE X-14 (Cont.)

Big Game Hunter Residence - 1973
Non-Resident Deer Hunters

	Game Management Unit														
State	1	2	3	4	5	10	11	12	13	14	15	23	24	26	441	Total
Nebraska				21			22					11				54
New Jersey			11				11									22
New Mexico					11		11									22
New York		22	10			22							11			65
North Carolina		10	22								32					64
Ohio	33	88	143			10	33	22	10	22		10		33		404
Oklahoma		33	33	11			65				22	22	11	11	11	219
Oregon		11		11					11							33
Pennsylvania	11	11	131	33	11	11	176	21	22	11						438
South Dakota							11									11
Tennessee		33	88				11	22				11				165
Texas	66	231	87	118	66	66	416	66	186	33	33	132	11	54		1,565
Utah	11	43		65		33										152
Virginia		22										32				54
Washington									22			11			11	44
West Virginia			11				11			11					11	44
Wisconsin		44	88	77	55	11	175	11	44	22	55	88	11			681
Wyoming			11				11									22
Total	263	1,424	1,906	931	307	514	2,572	416	580	277	230	810	154	142	99	10,625

* Species seasons -- total non-resident hunters.

TABLE X-15

Big Game Hunter Residence - 1973
Resident Elk Hunters

Planning Region	Game Management Unit 2	4	5	11	12	13	14	15	23	24	26	441	Total
1	1	7	30	9	28	79	65	15	17	17	0	0	268
2	14	106	90	23	58	224	222	111	99	51	27	20	1,045
3	72	501	612	119	777	1,435	936	732	936	510	456	134	7,220
4	10	43	29	7	44	79	85	58	84	51	65	19	574
5	0	6	0	0	20	0	5	7	12	6	0	0	56
6	0	0	8	0	0	15	1	13	16	0	7	0	60
7	0	19	0	8	0	15	5	0	12	0	0	0	59
8	2	59	0	0	0	0	1	6	0	0	13	0	81
9	0	0	0	0	0	0	6	0	0	0	0	0	6
10	0	12	0	7	7	6	9	13	11	5	0	7	77
11	130	355	61	115	330	300	71	20	337	187	47	25	1,978
12	21	9	52	0	109	534	323	253	12	11	28	41	1,393
13	0	5	2	0	10	13	33	19	29	0	26	2	139
Other	0	0	0	0	0	0	0	122	0	0	0	0	122
Total	250	1,122	884	288	1,383	2,700	1,762	1,369	1,565	838	669	248	13,078

TABLE X-16

Big Game Hunter Residence - 1973
Non-Resident Elk Hunters

State	Game Management Unit															
	1	2	3	4	5	10	11	12	13	14	15	23	24	26	441	Total
Alaska										1						1
Arizona					1				1	1		19				22
Arkansas				8			16	32	8	32	16	20	19	16		167
California		13		83	32		50	144	67	51	33	181	38	8	2	702
Connecticut				1												1
Washington D.C.													6			6
Florida				17			17		8	3						45
Georgia				9	21		14	8	24	1			7			84
Illinois				8	8		10	18	20	22	24	20	6	8		144
Indiana				8			9	33	25			12		9		96
Iowa				17	2		8	8	32	18		20		8	3	116
Kansas				17	9		8	8	49	35	8	12	19		9	174
Kentucky				8			8	8	8			13	7			52
Louisiana							16	8	8		8			8		48
Maryland					8							7				15
Michigan				75	2		16	11	81	4	25	96	6		9	325
Minnesota		1		8				2	9	46		19			8	93
Mississippi				33				8	8							57
Missouri		3		49	30		10	67	150	3	16	32	7	33	9	409
Nebraska		2			4		8		1	39		39		8		101
Nevada		4							11	9		19	25			68
New Jersey												7				7

TABLE X-16 (Cont.)

Big Game Hunter Residence - 1973
Non-Resident Elk Hunters

	Game Management Unit														
State	1	2	3	4	5	10	11	12	13	14	15	23	24	26	441	Total
New Mexico				9					8	8			7			32
New York								16	9						8	33
North Carolina							24									24
North Dakota								8				12				20
Ohio		4		24	8			17	16	13		45	6			133
Oklahoma				8	8			16	50		10	20	13	41		166
Oregon				8												8
Pennsylvania				49	25		8	56	187	16	8	32		1	8	390
South Dakota				8	10				8		16		6			48
Tennessee		4		8	1											13
Texas		9		65	32		56	98	91	51	49	69	20	18	8	566
Utah		1						8	16			7				32
Vermont				8												8
Washington												6				6
West Virginia										1		7				8
Wisconsin				8	8		1	24	65	35		51	6			198
Other*											2					2
Total		41		536	217		279	598	960	389	215	765	198	158	64	4,420

* Special seasons -- total non-resident hunters.

TABLE X-17

Fishing Visitor-Use Information for Lakes and Reservoirs in the Study Region

Name of Lake/Reservoir	Acres	Legal Description			Ownership Status	Fisherman Days/Yr.*
		T	R	Sec		
Beaver	8.6	9N	83W	10	Public	100
Big Creek Lake	8.2	8N	83W	-	Public	10
Diana	9.2	11N	83W	-	Public	20
Dinosaur	8.6	6N	83W	-	Public	200
Dome	4.7	8N	83W	4	Public	50
Dunkley	20.0	3N	88W	1	Public	0
Edward	11.8	8N	84W	19	Public	300
Elbert	11.0	8n	83W	-	Private	30
Elmo	10.0	6N	83W	-	Public	500
Farwell	5.0	10N	84W	18	Public	200
Fish Creek Res.	57.0	6N	83W	-	Public	2000 (20 on ice)
Fish Hawk	3.7	8N	84W	29	Public	200
Fish Hook	16.0	6N	83W	-	Public	500
Gardner Park Res.	47.0	1N	86W	14,15,22	Public	200
Gill Res.	7.5	3N	88W	11	Public	0
Gilpin	18.0	10N	83W	-	Public	1000
Gold Creek Lake	7.1	10N	83W	4	Public	300
Hahns Peak	40.0	10N	86W	12	Public	7150 (150 on ice)
Harper Res.	12.0	1N	86W	26, 27	Public	288
Lagunita	3.0	2N	83W	27	Public	250
Lake of the Crags	4.8	8N	83W	-	Public	20
Lake Pearl	167.0	10N	85W	35	Public	12050 (50 on ice)
Long	30.0	6N	83W	-	Public	100
Lost	14.0	6N	83W	-	Public	300
Luna	38.0	8N	83W	-	Public	500
Margaret	33.0	8N	84W	19	Public	500
Mica	5.5	10N	83W	-	Public	200
Mirror	6.4	8N	84W	19	Public	10
North	5.5	9N	83W	21	Public	900
Pristine, Lost Ranger	8.5	8N	83W	3	Public	10
Ptarmigan	7.0	8N	83W	-	Public	10
Quaker Mtn.	1.0	9N	87W	32	Public	12
Rosa	5.7	8N	84W	25	Public	100
Sage Creek Res.	20.0	5N	88W	13	Closed	20
Sanchez Lake (Lower)	4.6	11N	84W	25	Public	4
Sanchez Lake (Upper)	2.8	11N	84W	25	Public	4
Sellers	20.0	3N	88W	1,2	Public	0
Shaffer	20.0	3N	88W	2	Public	0
Snowstorm	8.3	8N	84W	30	Public	200

* Fisherman days are equivalent to activity days.

TABLE X-17 (Cont.)

Name of Lake/Reservoir	Acres	Legal Description T	R	Sec	Ownership Status	Fisherman Days/Yr.*
Steamboat	1083.0	10N	86W	-	Public	28000 (1200 on ic
Sunnyside Lake #1	5.0	1S	86W	3	Public	75
Sunnyside Lake #2	7.0	1S	86W	3	Public	75
Sunnyside Lake #3	2.5	1S	86W	3	Public	75
Three Island	23.2	9N	83W	-	Public	100
Wolverine	8.5	8N	82W	-	Public	50
Sub-Total for Routt County						56153 (1420 on ic (86.6% of study area tota
Butch Cassidy	100	10N	104W	12	Public	40
Freeman Res.	14	9N	89W	6	Public	525 (25 on ice)
Hog	51	10N	103W	9	Public	100
Ralph White	40	8N	90W	26	Public	600 (50 on ice)
Sub-Total for Moffat County						1175 (75 on ice) (1.8% of study area total
Axial Basin Res.	20	4N	93W	13	Private (Public access maintained)	375 (10 on ice)
Avery	263	1S	91W	7,18	Public	2000 (200 on ice
Allen Basin Res.	20	2N	86W	9	Public	700 (200 on ice
Chapman Res.	25	3N	86W	31	Public	210 (10 on ice)
Crosho	54	2N	86W	5	Public	750 (150 on ice
Watson	24	2N	86W	28	Public	75
Killarney	19	2N	87W	12,13	Public	100
Pagoda	7	2N	89W	23	Public	50
Rio Blanco	120	1N	96W	6	Public	500 (400 on ice
Sherriffs Res.	35	2N	87W	-	Public	160
Sizemore #1	2	1N	90W	21	Private	500 (50 on ice)
Vaughn	36	2N	88W	22	Public	2000
Sub-Total for Rio Blanco County Portion of Study Area						7520 (1020 on ic (11.6% of study area tota
Grand Total						64848

SOURCE: Colorado Division of Wildlife, 1972 Fisheries Inventory.

TABLE X-18

Fishing Visitor-Use Information for Streams

Stream Name	% Open to Public	Est. Fisherman Days/Yr.*
Adams	100	25
Agnes	100	10
Armstrong	100	6
Bear	100	10
Beaver (Walton)**	100	0
Beaver (Williams Fk.)	100	25
Beaver (Willow)	90	400
Big	60	900
N. Fork Big	100	10
Box	100	50
Burn	100	20
Cabin (Big, Elk)	100	10
Cabin	100	10
Chicken	90	25
Chimney	0	4
Circle	100	6
Clear	90	1
Coleman	0	5
Corral	100	2
Cottonwood	30	100
Coulton	90	10
Cranepale	100	50
Crawford	100	15
Day	10	0
Deep	10	2
Ditch	100	10
Douglas	100	15
Dutch	50	500
Egeria	10	10
N. Fork Elk River	98	1500
Middle Fork Elk River	100	500
S. Fork Elk River	100	500
Elk River #1	20	2000
Elk River #2	99	4000
Elkhead	100	10
Dry Fork Elkhead	100	0
N. Fork Elkhead	100	10
Middle Fork Elkhead	100	50
English	100	20
Finger Rock	0	10
S. Fork First	100	50
Middle Fork First	100	10
West Fork Fish	100	4
Fishook	100	50
Floyd	20	3
Gilpin	100	1000
Goldcreek	100	2000
Granite	100	50
Green Creek	95	50
Grizzle	50	50
Gunn	100	0
Harrison	95	50
Hinman	80	200
Hole-in-wall	100	6
Horse	100	20
Hot Spring	50	0
Hunt	0	30
Middle Fork Hunt	10	15
South Fork Hunt	60	20
North Fork Hunt	0	10
Independence	90	75
Indian Run	100	20
Johnson	100	10
King	0	20
King Solomon	100	200
Knowles	100	6
Larson	50	1500

* Fisherman days are equivalent to activity days (participation for all or part of one day).

**Parenthetical insertions denote drainages when duplicate names occur.

TABLE X-18 (Cont.)

Stream Name	% Open to Public	Est. Fisherman Days/Yr.*
Lester	100	1000
Little Red Park	100	30
Lopez	100	10
Lost Dog	100	20
Mad	70	200
Middle Fork Mad	100	50
S. Fork Mad	100	50
Mlkinnis	80	0
Mica	100	150
Middle	60	0
Mill (Steamboat Lake)	100	300
Mill (Dry Fk. Elkhead)	0	10
Miller	10	3
Morrison	30	100
Muddy	10	2
Oak	80	200
Oliver	100	10
Phillips, Chimney Rock	40	100
Porcupine (Mad)	100	1
Porcupine (Little Rock)	100	25
Priest	50	0
Red	50	5
Reed	80	10
Renfro	10	2
Roaring Fork	100	30
Rock (Elk River)	80	2
Little Rock (Big Rock)	100	50
Sanchez	100	3
Sand	70	10
Sawmill	100	6
Scotts Run	100	30
Second	5	0
Shoe and Stocking	100	100
Silver City	100	75
Slater	50	300
Smith (Deep)	80	70
Smith (Independence)	30	2
Little Snake River #1, (below Willow Creek)	0	75
Little Snake River #2, (above Willow Creek)	50	250
Middle Fk. Snake River	90	200
South Fk. Snake River	33	25
Soda	100	100
Spring	80	300
Stormking	100	0
Stukey	100	6
Summit	100	75
Teepee	100	25
Three Island	100	100
Torso	100	10
Tow	0	10
Trail	100	150
Little Trout	50	0
Walton	90	500
South Fork Walton	100	50
Watson	0	30
Whiskey (Big Rock)	100	15
Whiskey (M. Fk. L. Snake)	100	150
Williams Fork	100	50
S. Fork Williams Fork	100	20
Willow (Elk R.)	99	1200
Willow (L. Snake R.)	0	10
Wolverine	100	500
Yampa River (Elkhead Creek to Mt. Harris)	-	-
Yampa River (Mt. Harris to Service Creek)	-	-
Yampa (segment from Service Creek to Bear River)	60	1000
Sub-Total for Routt County (53.9% of study area total)		24087

TABLE X-18 (Cont.)

Stream Name	% Open to Public	Est. Fisherman Days/Yr.*
Little Bear	40	350
Beaver (Green River)	100	140
Beaver (Slater)	100	15
Cottonwood	70	300
Deer	100	10
Fortification	70	200
Green River	90	1200
Lynch	100	10
Roaring Fork Slater	100	20
Little Snake (below Colo. 318 crossing)	100	50
Little Snake (Wyo. to Powder Wash)	100	75
Snell Rock	100	10
Talamantes	100	25
Willow	95	30
Yampa River (Utah to Maybell)	90	300
Yampa River (Maybell to Elkhead Creek)	50	1,000
Sub-total for Moffat County (8.4% of study area total)		3,765
Big Beaver Creek	30	100
Black Mountain	100	12
Blue Mountain	100	2
Bunker	50	10
Coal	0	12
Corral	100	10
Cyclone	100	15
East Fork Beaver	100	6
Fawn	80	25
Fish	50	0
Lost	100	0
Moody	100	5
Morapos	100	20
Pagoda	100	15
Pine	100	10
Poose	100	20
Ripple	100	100
Rough	100	10
Slide	100	25
Snell	100	100
Trout	80	200
White River (Utah to Strawberry Ck. confluence)	5	100
White River (Strawberry to Buford)	10	10,000
N. Fork White River	10	5,000
S. Fork White River	50	1,000
E. Fork Williams Fork R.	100	50
Sub-Total for Rio Blanco County (37.7% of study area total)		16,857
Grand Total		44,709

SOURCE: Colorado Division of Wildlife, 1972 Fisheries Inventory.

TABLE X-19

1974 Fishery Questionnaire - User Origin

Region of Residence	Region Fished					
	Stream Fishing		Lake Fishing		Streams & Lakes Combined	
	11	12	11	12	11	12
1	5	75	13	58	18	133
2	24	307	23	397	47	704
3	522	3340	614	4835	1130	8175
4	6	100	32	144	38	244
5	0	0	1	28	1	28
6	0	6	0	5	0	11
7	28	45	36	23	64	68
8	4	0	0	18	4	18
9	6	9	0	13	0	22
10	57	8	105	3	162	11
11	1367	332	1212	152	2579	484
12	80	1305	47	577	127	1882
13	21	23	0	25	21	48
Resident Totals*	2120	5550	2083	6278	4203	11823
% of Total for State	9.19	24.05	6.38	19.23	7.54	21.23
Non-resident totals*	304	878	328	602	632	1475
% of Total for State	5.00	14.34	7.18	13.18	5.93	13.85
Totals in Region*	2424	6428	2411	6880	4835	13298
% Resident	87.5	86.3	86.4	91.2	86.9	88.9
% Non-resident	12.5	13.7	13.6	8.8	13.1	11.1

* Reported by numbers of fishermen.

SOURCE: Colorado Division of Wildlife, 1974 Fisheries Questionnaire.

TABLE X-20

1974

Number of Recreation Users from Region 11 (Activity Days)

Using Recreational Facilities in Other Planning Regions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13	Total Users
Hiking										313,036	2,234,427	215,887	43,177	
Horseback Riding											205,092			
Bicycling											4,047,874			
Motorcycling		21,589								64,766	593,688			
Driving for Fun		43,177	172,709	194,298						313,036	939,107	107,943	43,177	
Four-Wheeling									43,177		237,475	21,589		
Mountain Climbing														
Swimming										64,766	1,133,405	43,077		
Picnicking		43,177								21,589	589,688	151,121		
Camping		75,560							43,177	215,887	302,241			
Boating										21,589	356,213			
Game Playing				21,589			43,178				1,349,292			
Tennis											194,298	32,383		
Golf											356,213			
Fishing										215,887	1,727,096	140,326		
Shooting/Hunting									43,177	43,177	431,774	21,589		
Skiing/Snowshoeing											248,270	10.794		
Snowmobiling											151,121			
Sledding/Tobogganing/Tubing											356,213			
Ice Skating											53,972			
Other		64,766		21,589							442,568			
Region Totals		248,269	172,709	234,476			43,178		129,531	1,273,733	15,950,027	744,709	86,354	18,885,986
% of Total Use by Region 11 Residents	0.0	1.3	0.9	1.3	0.0	0.0	0.2	0.0	0.7	6.7	84.5	3.9	0.5	

TABLE X-21

1974

Number of Recreation Users from Region 12 (Activity Days)

Using Recreational Facilities in Other Planning Regions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13	Total Users
Hiking			86,354									3,141,944		
Horseback Riding												604,483		
Bicycling												2,288,398	269,859	
Motorcycling												172,709		
Driving for Fun			53,971				64,766				21,589	183,504	183,504	
Four-Wheeling												140,326		
Mountain Climbing			10,794							10,794			21,589	
Swimming			43,177								21,589	582,894		
Picnicking												151,120		
Camping											86,355	151,121	21,589	
Boating												269,858		
Game Playing												302,242		
Tennis												205,092		
Golf												53,972		
Fishing												464,156	21,589	
Shooting/Hunting												107,943		
Skiing/snowshoeing			43,177									3,342,382	53,972	
Snowmobiling												183,504		
Sledding/tobogganning/tubing												237,475		
Ice Skating												485,745		
Other			53,972									118,738		
Region Totals			291,445				64,766			10,794	129,533	13,687,606	572,102	14,756,246
% of Total Use by Region 12 Residents	0.0	0.0	2.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.9	92.8	3.9	

TABLE X-22

1974

Number of Recreation Users in Region 11 (Activity Days)

Recreation Users from Region:

Recreational Activities	State Planning Region: 1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total users
Hiking			334,624								2,234,427		32,383	528,540	3,129,974
Horseback Riding			550,511							43,177	205,092		32,383		831,163
Bicycling										75,560	4,047,874			42,947	4,166,381
Motorcycling			118,737								593,688			34,357	746,782
Driving for Fun		10,794	151,120							64,766	939,107	21,589		2,474,398	3,661,774
Four-Wheeling			291,447	43,177			10,794				237,475			94,483	677,376
Mountain Climbing															
Swimming			259,064	10,794							1,133,405	21,589		307,217	1,732,069
Picnicking			161,915							75,560	593,688			687,740	1,518,903
Camping			356,213	43,177	64,766		43,177			32,383	302,241	86,355	32,383	849,828	1,810,523
Boating			64,767								356,213			73,009	493,989
Game playing			43,177								1,349,292			64,420	1,456,889
Tennis											194,298			8,589	202,887
Golf			43,177								356,213			17,179	416,569
Fishing			971,490		64,766	10,794	10,794			53,972	1,727,096		64,766	473,305	3,376,983
Shooting/Hunting			151,121	43,177							431,774			142,615	768,687
Skiing/snowshoeing				10,794						10,794	248,270			182,158	452,016
Snowmobiling										43,177	151,121				194,298
Sledding/tobogganing/tubing											356,213				356,213
Ice Skating											53,972				53,972
Other										21,589	442,568			373,635	837,792
Region Totals		10,794	3,497,363	151,119	129,532	10,794	64,765	0	0	420,978	15,954,027	129,533	161,915	6,354,420	26,385,240
% of Total Region Use		0.0	13.0	0.6	0.5	0.0	0.2	0	0	1.6	59.3	0.5	0.6	23.6	

Aesthetics and Recreation

TABLE X-23

1974

Number of Recreation Users in Region 12 (Activity Days)

Recreation users from Region:

Recreational Activities	State Planning Region: 1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total users
Hiking		248,270	982,284	86,355							215,887	3,151,944		3,492,793	8,177,533
Horseback Riding		64,766										604,483	43,177	421,176	1,133,602
Bicycling			129,532									2,288,398		136,322	2,554,252
Motorcycling		43,178	53,971									172,709		64,420	334,278
Driving for Fun		205,098	464,156	161,915	43,177						107,943	183,504	10,794	6,686,339	7,862,926
Four-Wheeling		21,589	356,213								21,589	140,326		1,074,202	1,613,919
Mountain Climbing			129,532											47,539	177,071
Swimming			129,532	129,532							43,177	582,894		1,031,176	1,916,311
Picnicking		43,177	161,915								151,121	151,120		1,567,728	2,075,061
Camping	172,709	313,036	1,262,936	161,915								151,121		2,255,907	4,317,624
Boating		21,589	86,355	129,532								269,858		158,497	665,831
Game Playing		302,242										302,242		213,031	817,515
Tennis			21,589								32,383	205,092	21,589	200,113	480,766
Golf								10,794				53,972		358,536	423,302
Fishing	172,709	582,894	1,878,213	161,195							140,326	464,156		2,563,978	5,963,471
Shooting/Hunting		107,943	388,596	21,589					32,383		21,589	107,943	32,383	377,118	1,089,544
Skiing/snowshoeing	21,589	97,148	2,137,276	442,568			43,177				10,794	3,842,832	21,589	9,010,399	15,627,372
Snowmobiling			43,177									183,504		164,385	391,066
Sledding/Toboganning/tubing			161,915									237,475		329,364	728,754
Ice Skating												485,745		121,438	607,183
Other												118,738		416,582	535,320
Region Total	367,007	2,050,930	8,387,192	1,294,601	43,177	0	43,177	10,794	32,383	0	744,809	13,698,056	129,532	30,691,043	57,492,701
% of Total Region Use	0.6	3.6	14.6	2.3	0.1	0	0.1	0.0	0.1	0	1.3	23.8	0.2	53.4	

TABLE X-24

State Planning Region and National Population Projections, without the Proposed Actions; 1980, 1985, and 1990

Area	1974	1980	Average* Annual Growth Rate(%) 1974-1980	1985[1/]	Average* Annual Growth Rate(%) 1980-1985[1/]	1990[1/]	Average* Annual Growth Rate(%) 1985-1990[1/]
Colorado--State Planning Region							
1	65,756	69,001	0.81	71,827		74,769	
2	227,418	256,647	2.04	283,854		313,946	
3	1,486,837	1,858,979	3.79	2,239,324		2,697,489	
4	295,897	350,528	2.86	403,684		464,900	
5	19,837	20,536	0.58	21,137		21,756	
6	59,965	62,326	0.65	64,364		66,469	
7	151,278	158,178	0.75	164,168		170,384	
8	41,544	42,401	0.34	43,129		43,869	
9	42,262	44,553	0.88	46,557		48,651	
10	46,419	55,732	3.09	64,905		75,588	
11	89,374	114,950	4.28	137,971[2/]	3.72[2/]	160,762[2/]	3.10
12	46,347	61,193	4.74	73,666[2/]	3.78[2/]	86,465[2/]	3.26
13	44,674	50,750	2.49	57,377		64,869	
National	211,894,000	224,132,000	0.94	235,116,000[3/]	0.96[3/]	246,639,000	0.96

* Compounded annually

[1/] Computed using average annual growth rate 1974-1980.

[2/] See Regional Analysis, Chapter IV, Future Social Environment Without Proposed Action.

[3/] Computed using average annual growth rate 1980-1990.

SOURCES: For Planning Regions 1-10 & 13; Colorado Regional and County Population Estimates--1970-1980: Methods and Results.
For Planning Regions 11 and 12; see 2/ above.
For National; U.S. Bureau of Census; Current Population Reports, June, 1975, and Statistical Abstract of the U.S., 1974

TABLE X-25

Number of Recreation Users in Region 11 (Activity Days) in 1980
Without the Proposed and Possible Future Federal Actions

Recreational Activities	Recreation Users from Region: 1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total Users	Average Annual Increase(%) 1974-1980
Hiking			418,302								2,873,242		37,532	559,059	3,888,135	3.68
Horseback Riding			688,175							51,826	263,727		37,532		1,041,260	3.83
Bicycling										90,697	5,205,148			45,427	5,341,272	4.23
Motorcycling			148,429								763,421			36,341	921,191	3.56
Driving for Fun		12,184	188,910							77,740	1,207,594	28,504		2,617,675	4,132,607	2.04
Four-Wheeling			364,328	51,137			11,289				305,368			99,939	832,061	3.49
Mountain Climbing																
Swimming			323,847	12,784							1,457,442	28,504		324,956	2,147,533	3.65
Picnicking			202,404							90,697	763,522			727,452	1,784,075	2.72
Camping			445,290	51,137	67,053		45,157			38,870	388,651	114,015	37,532	898,899	2,086,604	2.39
Boating			80,963								458,053			77,225	616,241	3.75
Game Playing			53,974								1,735,050			68,140	1,857,164	4.13
Tennis											249,847			9,085	258,932	4.15
Golf			53,974								458,053			18,171	530,198	4.10
Fishing			1,214,427		67,053	11,222	11,289			64,784	2,220,867		75,065	500,635	4,165,342	3.56
Shooting/Hunting			188,911	51,137							555,217			150,850	946,115	3.52
Skiing/Snowshoeing				12,784						12,956	319,250			192,676	537,666	2.93
Snowmobiling										51,826	194,326				246,152	4.02
Sledding/Tobogganing/Tubing											439,253				439,253	3.55
Ice Skating											69,402				69,402	4.28
Other										25,914	569,097			395,209	990,220	2.83
Region Totals															32,831,423	3.39

TABLE X-26

Number of Recreation Users in Region 11 (Activity Days) in 1985 Without the Proposed and Possible Future Federal Actions

Recreation Users from Region:

Recreational Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total Users	Average Annual Increase(%) 1980-1985
Hiking			503,810								3,448,933		42,444	586,414	4,581,601	3.34
Horseback Riding			828,851							60,343	316,568		42,444		1,248,206	3.69
Bicycling										105,603	6,248,066			47,650	6,401,319	3.69
Motorcycling			178,771								916,382			38,119	1,133,272	4.23
Driving for Fun		13,479	219,218							90,517	1,449,551	34,314		2,745,759	4,552,838	1.96
Four-Wheeling			438,804	60,564			11,719				366,552			104,829	982,468	3.38
Mountain Climbing																
Swimming			390,047	14,720							1,749,459	34,314		340,856	2,529,396	3.33
Picnicking			243,779							105,603	916,503			763,047	2,028,932	2.61
Camping			536,316	60,564	69,020		46,876			45,258	466,522	137,256	42,444	942,883	2,347,139	2.38
Boating			97,481								549,830			81,004	728,315	3.40
Game Playing			65,007								2,082,689			71,474	2,219,170	3.63
Tennis											299,907			9,530	309,437	3.63
Golf			65,007								549,830			19,060	633,897	3.64
Fishing			1,462,678		69,020	11,591	11,719			75,431	2,665,846		84,887	525,131	4,906,303	3.33
Shooting/Hunting			227,528	60,564							666,462			158,231	1,112,785	3.30
Skiing/Snowshoeing				14,720						15,086	383,215			202,104	615,125	2.73
Snowmobiling										60,343	233,262				293,605	3.59
Sledding/Tobog-ganning/Tubing											527,263				527,263	3.72
Ice Sakating											83,308				83,308	3.72
Other										30,173	683,123			414,547	1,127,843	2.64
Region Totals															38,362,222	3.16

TABLE X-27

Number of Recreation Users in Region 11 (Activity Days) in 1990
Without the Proposed and Possible Future Federal Actions

Recreational Activities	Recreation Users from Region: 1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total Users	Average Annual Increase(%) 1985-1990
Hiking			606,799								4,017,705		47,998	615,108	5,287,610	2.91
Horseback Riding			998,284							70,261	368,774		47,998		1,485,318	3.54
Bicycling										122,958	7,278,450			49,981	7,451,389	3.08
Motorcycling			215,315								1,067,505			39,984	1,322,804	3.14
Driving for Fun		14,911	264,030							105,393	1,688,560	40,284		2,880,110	4,993,288	1.86
Four-Wheeling			528,503	69,734			12,165				427,001			109,958	1,147,361	3.15
Mountain Climbing																
Swimming			469,780	16,948							2,037,967	40,284		357,534	2,922,513	2.93
Picnicking			293,612							122,958	1,067,646			800,383	2,284,599	2.40
Camping			645,943	69,734	71,045		46,876			52,696	543,457	161,136	47,998	989,018	2,627,909	2.29
Boating			117,408								640,504			84,967	842,879	2.96
Game Playing			78,296								2,426,150			74,971	2,579,417	3.05
Tennis											349,365			9,996	359,361	3.04
Golf			78,296								640,504			19,993	738,793	3.11
Fishing			1,761,677		71,045	11,973	12,165			87,828	3,105,477		95,996	550,826	5,696,987	3.03
Shooting/Hunting			274,039	69,734							776,370			165,973	1,286,116	2.94
Skiing/Snowshoeing				16,968						17,565	446,412			211,993	692,938	2.41
Snowmobiling										70,261	271,730				341,991	3.10
Sledding/Tobog-ganning/Tubing											614,215				614,215	3.10
Ice Skating											97,047				97,047	3.10
Other										35,132	795,779			434,831	1,265,742	2.33
Region Totals															44,038,277	2.80

TABLE X-28

Number of Recreation Users in Region 12 (Activity Days) in 1980
Without the Proposed and Possible Future Federal Actions

Recreational Activities	Recreation Users from Region: 1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total Users	Average Annual Increase(%) 1974-1980
Hiking		280,251	1,227,920	102,274							277,608	4,161,538		3,694,474	9,744,065	2.96
Horseback Riding		73,109										798,104	50,043	445,496	1,366,752	3.17
Bicycling			161,924									3,021,391		144,194	3,327,509	4.51
Motorcycling		48,740	67,467									228,029		68,140	412,376	3.56
Driving for Fun		231,518	580,226	191,764	44,702						133,107	242,282	12,510	7,072,422	8,508,531	1.32
Four-Wheeling		24,370	445,290								27,762	185,274		1,136,228	1,818,924	2.01
Mountain Climbing			161,924											50,284	212,208	3.06
Swimming			161,924	153,411							55,521	769,600		1,090,718	2,231,174	2.57
Picnicking		48,739	202,404								194,326	199,525		1,658,252	2,303,246	1.75
Camping	181,274	353,360	1,578,754	191,764								199,526		2,386,168	4,890,846	2.10
Boating		24,370	107,949	153,411								356,296		167,649	809,675	3.31
Game Playing		341,175										399,053		225,332	965,560	2.81
Tennis			26,988								41,641	270,785	25,022	211,668	576,104	3.06
Golf								11,016				71,260		379,239	461,515	1.45
Fishing	181,274	657,979	2,347,891	191,764							180,445	612,829		2,712,027	6,884,209	2.42
Shooting/Hunting		121,848	485,771	25,569					34,131		27,762	142,518	37,532	398,894	1,274,025	2.64
Skiing/Snowshoeing	22,660	109,662	2,671,737	524,154			45,157				13,880	5,073,724	25,022	9,530,678	18,016,674	2.40
Snowmobiling			53,974									242,282		173,877	470,133	3.12
Sledding/Tobog-ganning/Tubing			202,404									313,540		348,382	864,326	2.88
Ice Skating												641,333		128,450	769,783	4.04
Other												156,771		440,636	597,412	1.85
Region Total															66,505,047	2.46

TABLE X-29

Number of Recreation Users in Region 12 (Activity Days) in 1985
Without the Proposed and Possible Future Federal Actions

Recreational Activities	Recreation Users from Region:															Average Annual Increase (%) 1980-1985
	1	2	3	4	5	6	7	8	9	10	11	12	13	Non-resident	Total Users	
Hiking		310,027	1,478,930	117,760							333,230	5,009,821		3,875,246	11,125,014	2.69
Horseback Riding		80,876										960,789	56,591	467,294	1,565,550	2.75
Bicycling			195,024									3,637,267		151,249	3,983,540	3.66
Motorcycling		53,918	81,960									274,510		71,474	481,862	3.16
Driving for Fun		256,116	698,835	220,800	46,013						159,777	290,270	14,147	7,418,479	9,104,437	1.36
Four-Wheeling		26,959	536,316								33,324	223,040		1,191,824	2,011,463	2.03
Mountain Climbing			195,024											52,744	247,768	3.15
Swimming			195,024	176,640							66,645	926,474		1,144,087	2,508,870	2.37
Picnicking		53,917	243,780								233,262	240,196		1,739,391	2,510,546	1.74
Camping	188,736	390,903	1,901,480	220,800								240,197		2,502,924	5,445,040	1.80
Boating		26,959	130,016	176,640								428,923		175,852	938,390	2.99
Game Playing		377,424										480,395		236,356	1,094,175	2.53
Tennis			32,504								49,984	325,981	28,296	222,025	658,790	2.72
Golf								11,205				85,786		397,795	494,786	1.40
Fishing	188,736	727,888	2,827,843	220,800							216,599	737,747		2,844,728	7,764,341	2.44
Shooting/Hunting		134,794	585,071	29,440					35,659		33,324	171,569	42,444	418,412	1,450,713	2.63
Skiing/Snowshoeing	23,592	121,313	3,217,890	603,520			46,876				16,661	6,107,946	28,296	9,997,019	20,163,113	2.28
Snowmobiling			65,007									291,668		182,385	539,060	2.77
Sledding/Tobogganing/Tubing			243,780									377,452		365,428	986,660	2.68
Ice Skating												772,062		134,735	906,797	3.33
Other												188,727		462,197	650,924	1.73
Region Total															74,631,839	2.33

Aesthetics and Recreation

TABLE X-30

Number of Recreation Users in Region 12 (Activity Days) in 1990
Without the Proposed and Possible Future Federal Actions

Recreational Activities	Recreation Users from Region: 1	2	3	4	5	6	7	8	9	10	11	12	6	Non-resident	Total Users	Average Annual Increase (%) 1985-1990
Hiking		342,266	1,781,250	135,591							388,184	5,881,428		4,064,864	12,593,583	2.51
Horseback Riding		89,469										1,127,947	63,997	490,159	1,771,572	2.50
Bicycling			234,890									4,270,078		158,650	4,663,618	3.20
Motorcycling		59,647	97,870									322,269		74,971	554,750	2.86
Driving for Fun		283,327	841,690	254,233	47,363						186,126	340,771	15,999	7,781,468	9,750,977	1.38
Four-Wheeling		29,824	645,949								38,820	261,844		1,250,140	2,226,577	2.05
Mountain Climbing			234,890											55,325	290,215	3.21
Swimming			234,890	203,386							77,636	1,087,662		1,200,068	2,803,642	2.25
Picnicking		59,646	293,613								271,730	281,985		1,824,500	2,731,474	1.70
Camping	196,505	432,436	2,290,178	254,233								281,986		2,625,393	6,081,731	2.24
Boating		29,824	156,594	203,386								503,547		184,457	1,077,808	2.81
Game Playing		417,524										563,974		247,923	1,229,421	2.36
Tennis			39,149								58,227	382,695	31,999	232,889	744,959	2.49
Golf								11,396				100,711		417,260	529,367	1.36
Fishing	196,505	821,651	3,405,908	254,233							252,319	866,100		2,983,921	8,780,637	2.49
Shooting/Hunting		149,115	704,671	33,898					37,256		38,820	201,419	47,998	438,885	1,652,062	2.63
Skiing/Snowshoeing	24,563	134,203	3,875,687	694,903			48,660				19,409	7,170,605	31,999	10,486,174	22,486,203	2.20
Snowmobiling			78,296									342,412		191,309	612,017	2.57
Sledding/Tobogganing/Tubing			293,613									443,121		383,309	1,120,043	2.57
Ice Skating												906,385		141,328	1,047,713	2.93
Other												221,562		484,812	706,374	1.65
Region Total															83,454,743	2.26

TABLE X-31

Number of Recreation Users from Region 11

Using Recreational Facilities in Other Planning Regions
in 1980
(Activity Days)
With the Proposed and Possible Future Federal Actions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13
Hiking										433,595	3,094,968	299,031	59,806
Horseback Riding											284,079		
Bicycling											5,606,824		
Motorcycling		29,903								89,709	822,334		
Driving for Fun		59,806	239,224	269,128						433,595	1,300,784	149,515	59,806
Four-Wheeling									59,806		328,933	29,903	
Mountain Climbing													
Swimming										89,709	1,569,911	59,667	
Picnicking		59,806								29,903	816,793	209,322	
Camping		104,660							59,806	299,031	418,643		
Boating										29,903	493,401		
Game Playing				29,903			59,807				1,868,942		
Tennis											269,127	44,855	
Golf											493,401		
Fishing										299,031	2,392,249	194,369	
Shooting/Hunting									59,806	59,806	598,062	29,903	
Skiing/Snowshoeing											343,886	14,951	
Snowmobiling											209,322		
Sledding/Tobogganning/Tubing											493,401		
Ice Skating											74,758		
Other		89,709		29,903							613,013		

TABLE X-32

Number of Recreation Users from Region 11

Using Recreational Facilities in Other Planning Regions
in 1985
(Activity Days)
With the Proposed and Possible Future Federal Actions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13
Hiking										508,785	3,631,671	350,886	70,177
Horseback Riding											333,342		
Bicylcling											6,579,111		
Motorcycling		35,088								105,266	964,936		
Driving for Fun		70,177	280,708	315,798						508,785	1,526,354	175,443	70,177
Four-Wheeling									70,177		385,973	35,089	
Mountain Climbing													
Swimming										105,266	1,842,151	70,013	
Picnicking		70,177								35,089	958,434	245,621	
Camping		122,809							70,177	350,886	491,240		
Boating										35,089	578,962		
Game Playing				35,089			70,178				2,193,038		
Tennis											315,797	52,633	
Golf											578,962		
Fishing										350,886	2,807,092	228,075	
Shooting/Hunting									70,177	70,177	701,773	35,089	
Skiing/Snowshoeing											403,520	17,544	
Snowmobiling											245,621		
Sledding/Tobogganning/Tubing											578,962		
Ice Skating											87,721		
Other		105,266		35,089							719,316		

TABLE X-33

Number of Recreation Users from Region 11

Using Recreational Facilities in Other Planning Regions
in 1990
(Activity Days)
With the Proposed and Possible Future Federal Actions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13
Hiking										589,249	4,206,016	406,378	81,275
Horseback Riding											386,060		
Bicycling											7,619,591		
Motorcycling		40,637								121,914	1,117,540		
Driving for Fun		81,275	325,102	365,741						589,249	1,767,745	203,189	81,275
Four-Wheeling									81,275		447,014	40,638	
Mountain Climbing													
Swimming										121,914	2,133,485	81,085	
Picnicking		81,275								40,638	1,110,009	284,466	
Camping		142,231							81,275	406,378	568,929		
Boating										40,638	670,524		
Game Playing				40,638			81,277				2,539,864		
Tennis											365,740	60,957	
Golf											670,524		
Fishing										406,378	3,251,031	264,145	
Shooting/Hunting									81,275	81,275	812,758	40,638	
Skiing/Snowshoeing											467,336	20,319	
Snowmobiling											284,466		
Sledding/Tobogganning/Tubing											670,524		
Ice Skating											101,594		
Other		121,914		40,638							833,075		

TABLE X-34

Number of Recreation Users from Region 12 in 1980 (Activity Days) With the Proposed and Possible Future Federal Actions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13
Hiking			117,520									4,275,887	
Horseback Riding												822,644	
Bicycling												3,114,292	367,252
Motorcycling												235,041	
Driving for Fun			73,449				88,140				29,381	249,731	249,731
Four-Wheeling												190,970	
Mountain Climbing			14,690							14,690			29,381
Swimming			58,760								29,381	793,263	
Picnicking												205,660	
Camping											117,521	205,661	29,381
Boating												367,251	
Game Playing												411,323	
Tennis												279,111	
Golf												73,451	
Fishing												631,672	29,381
Shooting/Hunting												146,900	
Skiing/Snowshoeing			58,760									5,229,116	73,451
Snowmobiling												249,731	
Sledding/Tobogganning/Tubing												323,181	
Ice Skating												661,053	
Other			73,451									161,591	

TABLE X-35

Number of Recreation Users from Region 12

Using Recreational Facilities in Other Planning Regions
in 1985
(Activity Days)
With the Proposed and Possible Future Federal Actions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13
Hiking			141,271									5,140,043	
Horseback Riding												988,900	
Bicycling												3,743,690	441,474
Motorcycling												282,543	
Driving for Fun			88,293				165,953				35,319	300,202	300,202
Four-Wheeling												229,565	
Mountain Climbing			17,659							17,659			35,319
Swimming			70,635								35,319	953,581	
Picnicking												247,224	
Camping											141,272	247,225	35,319
Boating												441,472	
Game Playing												494,451	
Tennis												335,519	
Golf												88,295	
Fishing												759,333	35,319
Shooting/Hunting												176,588	
Skiing/Snowshoeing			70,635									6,285,919	88,295
Snowmobiling												300,202	
Sledding/Tobogganing/Tubing												388,496	
Ice Skating												794,652	
Other			88,295									194,249	

TABLE X-36

Number of Recreation Users from Region 12

Using Recreational Facilities in Other Planning Regions
in 1990
(Activity Days)

With the Proposed and Possible Future Federal Actions

Recreational Activities / State Planning Region:	1	2	3	4	5	6	7	8	9	10	11	12	13
Hiking			165,689									6,028,465	
Horseback Riding												1,159,825	
Bicycling												4,390,762	517,780
Motorcycling												331,379	
Driving for Fun			103,354				124,266				41,424	352,090	352,090
Four-Wheeling												269,244	
Mountain Climbing			20,711							20,711			41,424
Swimming			82,844								41,424	1,118,401	
Picnicking												289,955	
Camping											165,690	289,956	41,424
Boating												517,777	
Game Playing												579,914	
Tennis												393,511	
Golf												103,556	
Fishing												890,579	41,424
Shooting/Hunting												207,110	
Skiing/Snowshoeing			82,844									7,372,398	103,556
Snowmobiling												352,090	
Sledding/Tobogganning/Tubing												455,645	
Ice Skating												932,002	
Other			103,556									227,824	

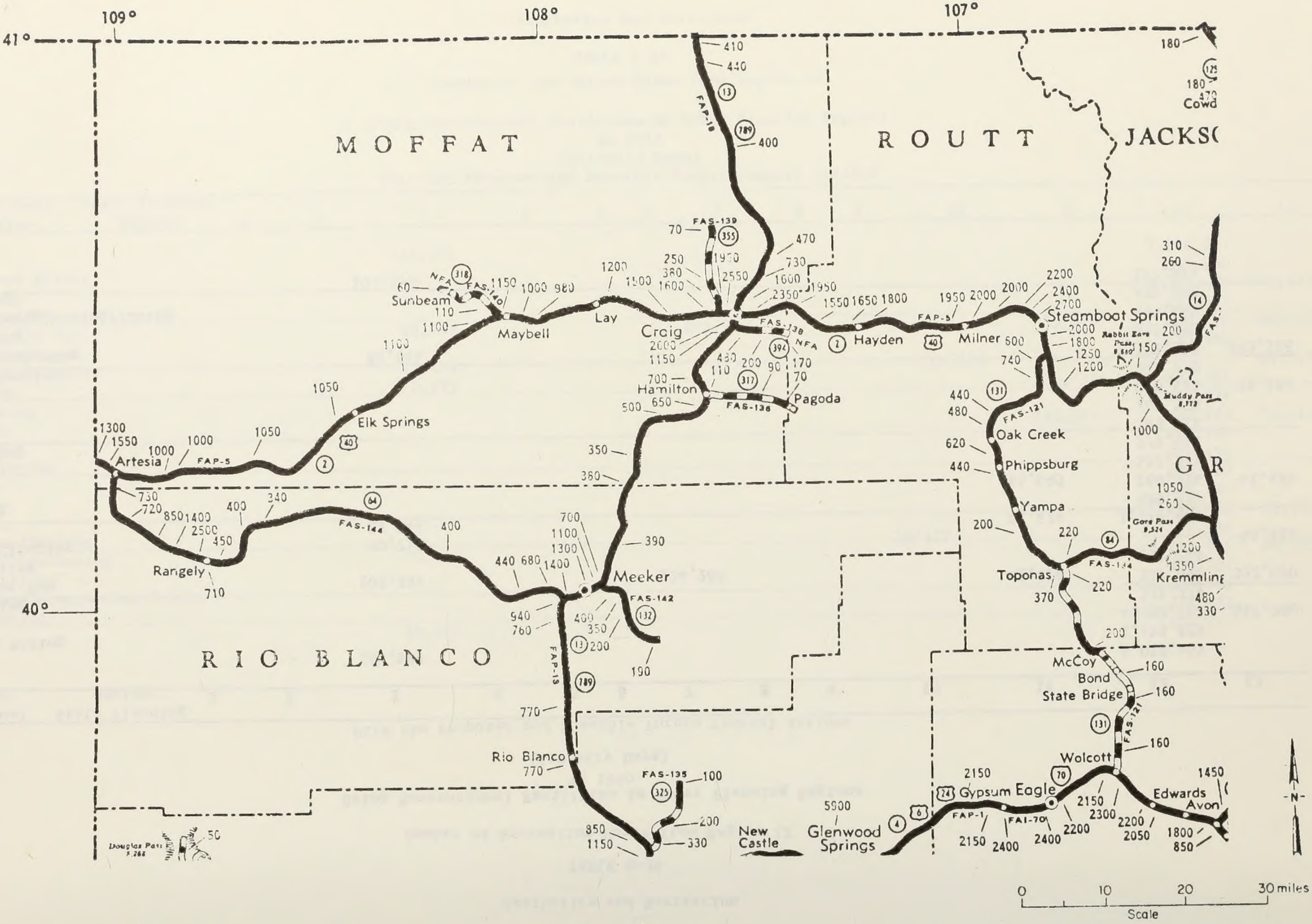

FIGURE X-1

Average daily traffic (ADT) volumes - 1965.

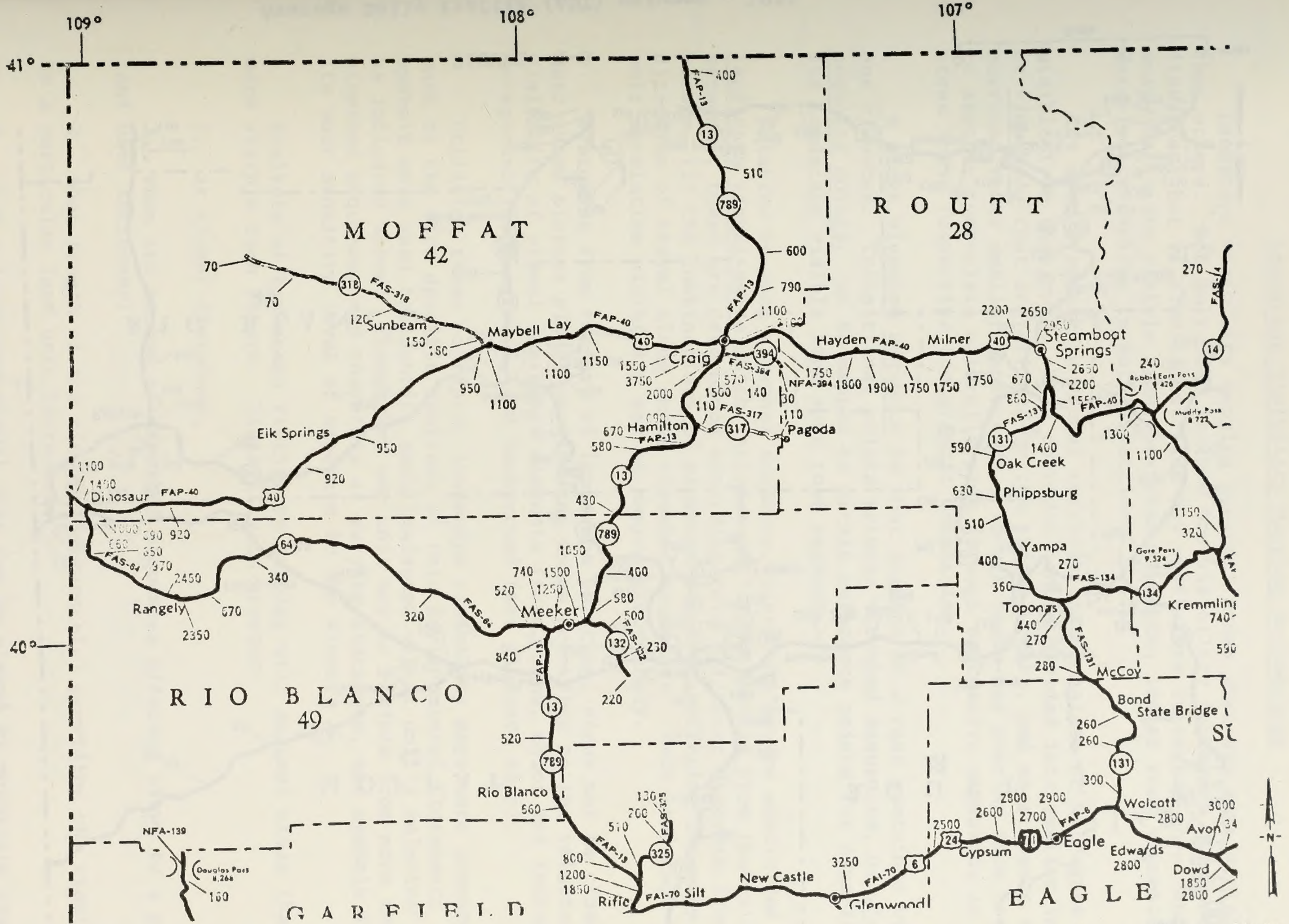

FIGURE X-2

Average daily Traffic (ADT) volumes - 1970.

SOURCE: Colorado Division of Highways

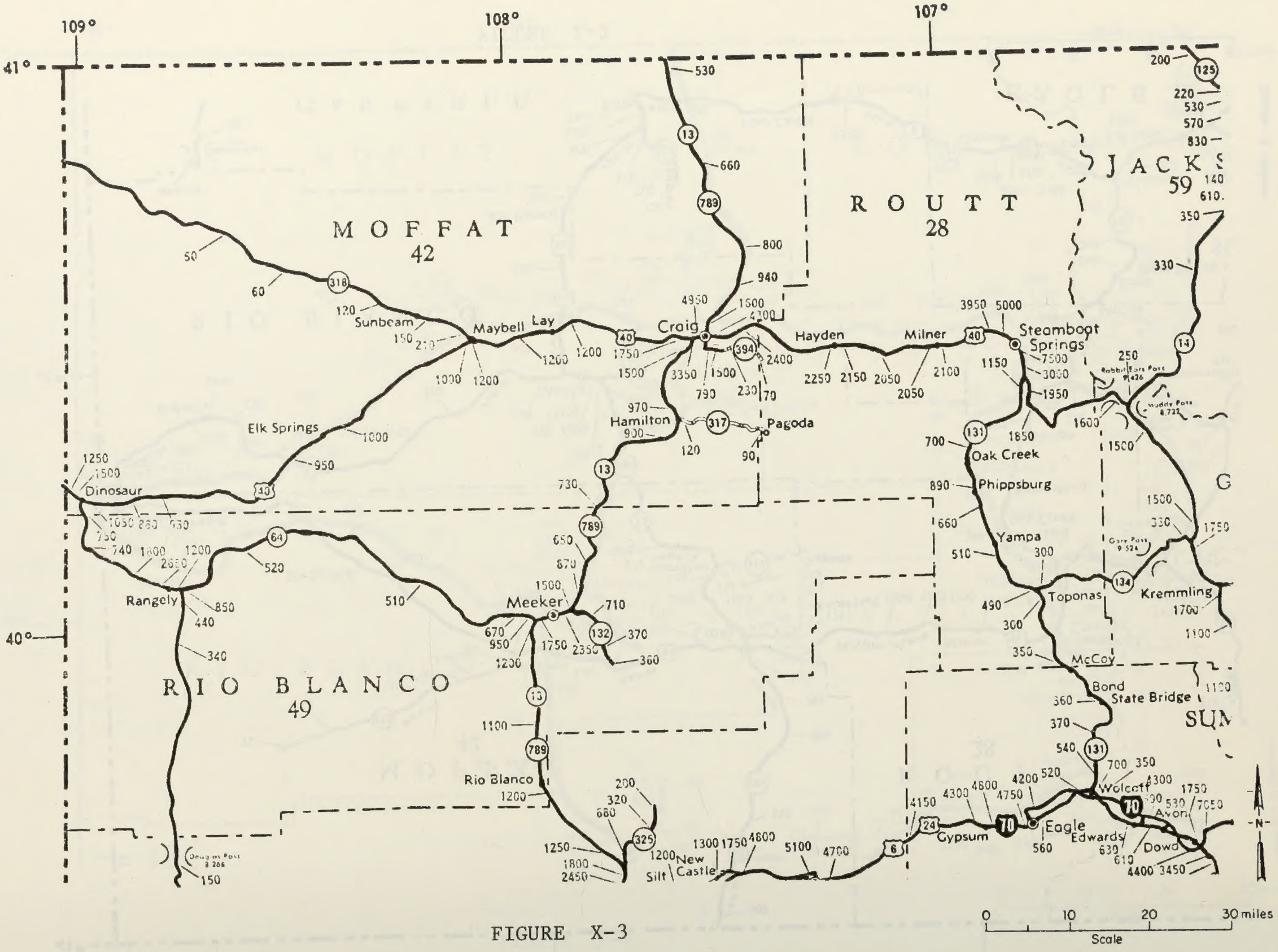

FIGURE X-3

Average Daily traffic (ADT) volumes - 1974.

Landscape Visibility Mapping Methodology

Landscape visibility mapping suggests areas that are more visible than others. Not only does it show how visibility increases at closer distances, but it also illustrates how visibility increases when landscape units are visible from more road sigments, longer road segments, and by motorists traveling in both directions.

Any road traverses a visual corridor that consists of all areas visible from that road. This corridor can be divided into smaller landscapes or viewsheds that are defined by the ridges, peaks, and escarpments that surround these smaller landscapes. Though views may overlap from one viewshed to another, motorists naturally pass through successive viewsheds as they cross their respective topographic boundaries.

A singe viewshed sequence is that segment of a road contained by any one viewshed. Transitional points between viewshed sequences, or viewshed sequence points, can be mapped to obtain reference points for classifying the landscape visible from each road segment.

Relative to each viewshed sequence, viewsheds may be subdivided into landscape visual units which includes all areas visible from that viewshed sequence; these are determined according to: (1) their distance from the viewer, (2) the combinations of viewshed sequences offering the view, and (3) the direction of travel along these viewshed sequences. Each landscape visual unit's relative visibility may be mapped accordingly.

Borrowing from the art of landscape painting, views may be classified into three picture planes or distance zones according to the relative visibility of visual dominance elements (form, line, color and texture): foreground, middleground, and background (see glossary also).

Utilizing these concepts, landscape visibility maps were prepared for each of the site specific analyses of this Environmental Statement. Mapping symbols were used to identify each landscape visual unit's relative visibility, as indicated above. Though any one unit may be visible from more than one viewshed sequence, and therefore at varying distances, map symbols indicate its most sensitive level of exposure to the viewer.

Analysis of Landscape Visibility Mapping will suggest areas that are more visible than others. Visibility is greater:

1. at closer distances,

2. when the number of viewshed sequences offering views to a particular land unit increases;

3. when length of the viewshed sequence(s) providing the view(s) to a particular land unit increases;

4. when a landscape visual unit can be viewed by motorists traveling in both directions; and

5. when a land unit lies at a greater angle of exposure to the viewer (measures both in terms of slope, with respect to vertical alinement, and aspect, with respect to horizontal alinement).

Landscape Visibility Map Analysis for Visual Environmental Impact Assessment

The areas to receive the greatest impacts would be those in which actions being proposed do not borrow from the characteristic landscape. Expressed in another way, when the dominance element (form, line, color, and texture) inherent in the proposed action does not complement those of the landscape into which it is to be placed, it will not "fit", and is therefore a minus deviation or adverse visual impact.

It is important to note that not all obvious changes in existing landscape character would be adverse; some may borrow from the characteristic landscape and therefore be termed plus deviations; these would maintain visual harmony, and if they increase landscape variety, would also increase scenic value.

These concepts were combined with those in the previous section to complete the impact analyses in the site specific sections of the Environmental Statement (see Chapter III in each analysis).

Social Environment
and
Economic Conditions

APPENDIX D

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FOR
SOCIAL ENVIRONMENT
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Economic Conditions

Regional Population Employment Model

The most frequently used form of regional employment projection model is the export base analysis. Although there are numerous variations of this type of analysis, the most common form is one which utilizes past employment trends to derive an employment multiplier similar to the familiar Keynesian income multiplier. A simple export base model could be represented as:

$$ET = EX + EL$$
$$EL = aEX$$
$$ET = EX + aEX$$
or
$$\Delta ET = WEX\ (1.0 + a)$$

where

ET is total employment,
EX is export-oriented employment (exogenous),
EL is locally-oriented employment, and
a is a coefficient estimated from a previous time period.

Given an expected level of employment in the export sectors, the multiplier is used to estimate the local service employment, and thus, the total employment which will occur as a result of a given level of export activity. Most State and local employment projections are based upon an export base analysis similar to the one outlined above. The employment projection model which was used for the Northwest Colorado Coal ES is a modified export base analysis which has been linked to a cohort-survival population model. This model has been used to estimate total employment and population levels associated with projected levels of construction and operating employment for several potential energy-related industrial developments in the study area. A brief description and background of the working model follows.

A modified export base model

Czamanski (1964) has outlined a more detailed export base model for regional growth which considers the locational aspects of urban employment. For this model, all types of economic activity are divided into geographically-oriented industries, complementary industries, and urban-oriented industries.

Geographically-oriented industries may be defined as:

> ...industries whose main locational factors are geographical or conditioned by the environment. In this group fall extracting industries (resources-oriented), processing industries (industries in which a significant proportion of their labor force is employed in

> processes depending directly on raw material inputs), industries depending on a large supply of good water, etc., transportation centers, and large establishments employing more than, say, 10,000 workers on one site. By definition, investments in this category of economic activity do not depend on the size and character of urban development (p. 183).

Complementary industries are:

> ...industries for which the main locational factor is the presence of other industries. In this category fall all enterprises producing services or goods for a limited number of large customers (geographically-oriented industries) located in the same urban area (p. 183).

Urban-oriented industries may be defined as:

> ...industries for which the existence of the city is the main locational factor. This category comprises services which cannot be transported, industries using female labor otherwise unemployed, using the urban labor pool and various other facilities, small establishments for which the possibility of using power supplied by municipal power plants, municipal water, etc. is important. This category includes many more industries than just the market-oriented activities singled out by some other urban-growth models (p. 184).

Based on these definitions, the Czamanski model may be formulated as:

$$P = a_1 + b_1 E_T$$
$$E_T = E_g + E_c + E_u$$
$$E_g = \text{exogenous}$$
$$E_c = a_2 + b_2 E_g$$
$$E_u = a_3 + b_3 P$$

where

P is population,
E_T is total employment,
E_g is geographically oriented employment,
E_c is complementary employment,
E_u is urban oriented employment,
a_1, a_2, a_3 are constants estimated from regression analysis, and
b_1, b_2, b_3 are the corresponding coefficients from the regression results.

This set of relationships can be used to calculate an employment multiplier for the region. By substitution:

$$E_T = \frac{E_g + a_2 + b_2 E_g + a_3 + b_3 a_1}{1.0 - b_3 b_1}$$

or

$$\Delta ET = \frac{\Delta E_g + a_2 + b_2 \Delta E_g + a_3 + b_3 a_1}{1.0 - b_3 b_1}$$

An employment model for the study area

In recent years, several large-scale regional modeling efforts have utilized a Czmanski type approach to problems of employment projections (San Diego County Comprehensive Planning Organization, 1972; Hamilton, et al., 1969; Monarchi, 1974). All of these studies have used an industry determinization scheme similar to the one outlined earlier. The most obvious shortcoming to this approach, as it has been used, is that the market orientation designation has been mutually exclusive in regard to external trade. For example, complementary industries and urban-oriented industries are assumed to be oriented completely toward the internal markets of the region. As a consequence, imports and exports associated with these industries must be assumed to be zero, or alternatively, they must be assumed to exactly balance each other in each industry (net exports equal zero for each industry). While this problem may not be severe for large urban regions or smaller closed regions, it will definitely impose severe limitations upon the analysis when applied to smaller, more open economies, such as counties or rural trading areas. In order to more adequately account for imports and exports in small regions, a more specific treatment of external trade is used for the present model.

Assume that the Czamanski market orientation scheme outlined earlier is valid and applicable to some region under study so that the following identity holds:

$$E_T = E_B + E_{BS} + E_{PS}$$

$$P = B_1 ET$$

where

E_B is basic industry employment which is much the same as the earlier geographically oriented employment. Assume that, as before, these industries are completely market-oriented and that their levels are exogenously determined;

E_{PS} is population service employment (similar to urban-oriented employment);

E_{BS} is business-serving employment which is complementary to both basic industry employment and population-serving employment;

P is population; and

E_T is total employment.

In contrast to the usual approach of assuming a completely internal orientation for business-serving employment (E_{BS}) and population-serving employment (E_{PS}), export-oriented employment is included in both industry types so that:

$$E_{BS} = E^L_{BS} + E^X_{BS}$$

$$E_{PS} = E^L_{PS} + E^X_{PS}$$

where

L denotes locally oriented employment, and
X denotes export employment.

Based upon these definitions, the following model can be formulated:

$$E_T = E_B + E_{BS} + E_{PS}$$

$$E_B = \text{exogenous}$$

$$E_{BS} = E^L_{BS} + E^X_{BS}$$

$$E^X_{BS} = \text{exogenous}$$

$$E_{PS} = E^L_{PS} + E^X_{PS}$$

$$E^X_{PS} = \text{exogenous}$$

$$P = b_1 E_T$$

$$E^L_{BS} = b_2 (E_B + E_{PS})$$

$$E^L_{PS} = b_3 P$$

where

all terms are as defined previously.

The locally oriented business-serving employment (E^L_{BS}) is thus a complementary industry to the basic industry employment in the region (E_B), and also to the population-serving employment (E_{PS}). Note that the business-serving employment locally (E^L_{BS}) must serve not only the locally-oriented population-serving employment (E^L_{PS}), but also the export component of population-serving employment (E^X_{PS}). The locally-oriented population-serving employment (E^L_{PS}) serves only the resident population of the region (P).

The system of equations above may be solved by substitution to yield:

$$E_T = \frac{E_B\ (1.0 + b_2) + E^X_{PS}\ (1.0 + b) + E^X_{BS}}{1.0 - b_2 b_3 b_1 - b_3 b_1}$$

or

$$\Delta E_T = \frac{\Delta E_B\ (1.0 + b_2) + \Delta E^X_{PS}\ (1.0 + b_2) + \Delta E^X_{BS}}{1.0 - b_2 b_3 b_1 - b_3 b_1}$$

This model is a modified form of the usual economic base approach in which exogenous or export employment is the primary driving force in the local economy. While it seems very likely that exports will provide the main impetus for change in this model framework also, it is not, as with the usual approach, a foregone conclusion. Using these model assumptions, the local economy can change as a result of changes which may occur in the population structure, as well as changes in the export base. However, as is the case with all economic base approaches, this model does require that export-oriented employment be separated from total employment and projected to some future time.

Estimating export employment

Since very few economic base studies are actually based upon survey research, several short-cut methods for calculating exports have evolved in recent years. The two most widely known procedures are the location quotient technique (Hirsch, 1973; Leigh, 1970) and the minimum requirements technique (Ullman, et al, 1971).

The procedure for estimating export and local employment for the model developed here is a synthesis of these two approaches. That is, some export employment is estimated based solely upon employment (location quotient), and some estimated as a function of population (minimum requirements). Earlier, a regional employment model was specified. Let us assume a corresponding national model, where net exports are essentially zero, so that the following relationships describe the system:

$$NET = NEB + NEBS + NEPS$$

$$NEB = \sum_{i=1}^{j} NEB_i$$

$$NEBS = \sum_{i=1}^{k} NEBSi$$

$$NEPS = \sum_{i=1}^{m} NEPSi$$

$$CBSi = NEBSi / (NEB + NEPS)$$
$$CPSi = NEPSi / NP$$

where

NET, NEB, NEBS, NEPS, and NP represent national values for employment and population which correspond to the regional definitions and the subscript i represents the individual industries which make up the three employment groups,

CBSi is a coefficient which shows the relationship between employment in business-serving industry i and the total employment in basic and population-serving employment, and

CPSi is a coefficient which identifies the relationship between employment in population-serving industry i and the total population.

Assume that base year employment and population values are available for the region so that EBi's, EBSi's and EPSi's are known. Regional values for the national relationships could be calculated as:

DBSi = REBSi / (REB + REPS)

DPSi = REPSi / RP

where

DBSi and DPSi represent actual observed relationships in the region for the base year.

Since the observed regional values (i.e., DBSi and DPSi) reflect local imports and exports, these values will likely differ significantly from the national values (CBSi and CPSi), which reflect only current technology. A regional employment requirement then would be given by:

RREBSi - CBSi . (REB + REPS)

RREPSi = CPSi . RP

where

RREBSi is the required regional employment in regional business-serving industry i, and

RREPSi is the required regional employment in regional population-serving industry i.

Net export employment for each industry in the region for the base year would be:

XREBSi - RREBSi - REBSi

XREPSi - RREPSi - REPSi

where

XREBSi and XREPSi are net export employment for the region for a particular industry i, and

REBSi and REPSi are the observed values for regional industries for the base year.

A negative net export value would thus indicate imports, and a positive value would identify exports. Since imports represent an inability of the regional system to fully capture employment effects, an allowance must be made for this propensity to import. Thus, for each industry which has a negative net export (i.e., imports), the actual employment requirement which exists in the region is less than the total employment requirement which was calculated using the national relationships. For each industry which has positive net exports, the total employment requirement is identical to the requirement calculated from the national relationships.

The actual employment requirements for each industry in the region are thus calculated as:

$$\mathrm{ARREBSi} = \{\min\ (\mathrm{CBSi},\ \mathrm{DBSi})\}\ .\ (\mathrm{REB} + \mathrm{REPS})$$

$$\mathrm{ARREPSi} = \{\min\ (\mathrm{CPSi},\ \mathrm{DPSi})\}\ .\ \mathrm{RP}$$

where

ARREBSi is the actual required regional employment in business-serving industry i,

ARREPSi is the actual required regional employment in population-serving industry i,

min (CBSi, DBSi) is the lesser of CBSi and DBSi, and

min (CPSi, DPSi) is the lesser of CPSi and DPSi.

These actual employment requirements thus represent the employment relationships which are present in the regional system. The propensity to import has been identified, and the base year values for export employment have been estimated. (Note that this model formulation does not preclude a variable propensity to import.) The employment model is completed as follows:

$$\overset{k}{b_2} = \sum_{i=1}^{k} \{\min\ (\mathrm{CBSi},\ \mathrm{DBSi})\}$$

$$b_3 = \sum_{i=1}^{m} \{\min\ (\mathrm{CPSi},\ \mathrm{DPSi})\}$$

$$\mathrm{REBS} = b_2\ (\mathrm{REB} + \mathrm{REPS}) + \mathrm{XREBS}$$

$$\mathrm{REPS} = b_3\ (\mathrm{RP}) + \mathrm{XREPS}$$

where

XREBS and XREPS are now the values for export regional employment (only the positive net exports).

With the calculation of the b_2 and b_3 values and the base year export employment, the employment model is identical to the model specified in the previous section. The industry classification scheme and the coefficient values used for the model are shown in Tables XI-1 and XI-2.

TABLE XI-1 - Industry Classification Scheme

Basic Industries

Industry description	S.I.C.
Agriculture	01,07-09
Mining	10-14
Furniture, lumber and wood products	24-25
Metal industries	19, 33-34
Machinery, except electrical	35
Electrical machinery	36
Transportation equipment	37
Other durable goods	32, 38-39
Food and kindred products	20
Textiles and textile products	22-23
Chemical and allied products	28
Other non-durable goods	21, 26, 29-31
All transportation	40-47
Wholesale trade	50
Federal government	91

Business-Serving Industries

Industry description	S.I.C.
Construction	15-17
Printing and publishing	27
Communications	48
Utilities and sanitary services	49
Business and repair services	73-76
Legal, engineering, and misc. professional services	81, 89

Population-Serving Industries

Industry description	S.I.C.
Food, bakery, and dairy stores	54
Eating and drinking places	58
General merchandise retailing	53
Motor vehicles sales and service stations	55
Other retail trade	52, 56-59
Finance, insurance, and real estate	60-67
Personal services	70, 72, 88

TABLE XI-1 - Industry Classification Scheme (Cont.)

Industry description	S.I.C.
Entertainment and recreation services	78-79
Hospitals and health services	80
All education	82, 84
Welfare, religious and non-profit services	86
Public administration, except federal	92-93

TABLE XI-2 Employment Coefficients

Coefficient	National	Moffat County	Rio Blanco County	Routt County
b_1 (1970)	2.64142	2.60687	2.48818	2.60863
b_2[2]	.19459	.16339	.15659	.16465
b_3[2]	.17268	.15291	.14916	.13110
BSi[1]				
1	.07135	.07135	.07135	.07135
2	.01859	.00204	.00308	.00830
3	.01675	.01675	.00001	.00928
4	.02004	.02004	.02004	.02004
5	.03737	.03737	.03737	.02784
6	.03049	.01584	.02465	.02784
PSi[1]				
1	.00946	.00919	.00805	.00946
2	.01137	.01137	.00867	.01137
3	.01032	.00659	.00351	.00516
4	.00840	.00840	.00599	.00840
5	.02098	.02098	.01900	.02098
6	.01898	.00828	.01157	.01107
7	.01749	.01749	0.1749	.01749
8	.00312	.00312	.00312	.00312
9	.02100	.02100	.02100	.00334
10	.03040	.03040	.03040	.03040
11	.00575	.00276	.00496	.00485
12	.01540	.01333	.01540	.00546

---

[1] These coefficients are the lesser of the observed regional coefficient for the base year (DBSi and DPSi), and the observed national coefficient for the base year (CBSi and CPSi).

[2] b_2 is the sum of the BSi coefficients; b_3 is the sum of Psi coefficients.

The Population Projection Component

The modified export base model outlined heretofore can be used to estimate the total employment for the region, and thus may be used to calculate a direct estimate of population via some ratio application. This is the most frequently used technique for population projections with the export base analysis. The population projection method used for this study includes a cohort-survival model which considers changing age and sex composition patterns as well as migration estimates. The model is primarily an accounting device which records age and sex population totals over time, and is designed to replicate the processes of population change over time. The model thus includes three components: births, deaths, and net migration. The population of any area open to migration may change as a result of births entering the system, deaths leaving the system, or net migration. These processes could be represented as:

$$P(t) = P(t-1) + BTHS - DTHS + NM$$

where

$P(t)$ is the population this time period,

$P(t-1)$ is the population the previous time period,

BTHS and DTHS are the births and deaths which have occurred in the intervening period, and

NM is the net migration (in-migration minus out-migration) between periods.

The cohort-survival model is used to calculate and record births and deaths as well as aging, while the net migration estimate is handled separately.

A cohort-survival model

Rather than a total population, the cohort-survival model is designed to monitor population change by age and sex. The analysis begins with a base year population separated into age and sex groups such that:

$$TROP = \sum_{j=1}^{2} P_{ij} \quad (i = 1, 2, 3 \ldots\ldots n)$$

where

TROP is the total population,

P_{ij} is the population of age group i, sex j (male = 1, female = 2), and

n is the number of age groups.

Although any reasonable age grouping may be used, the most common practice considers five year age intervals (for example, age group 1 is age 0-4 years, group 2 is 5-9 years, group 3 is 10-14 years, etc.).

Births are calculated as a function of the female population in childbearing age groups and the birth rate for that group:

$$BTHS = \sum_{i=1}^{m} BR_i P_{i2}$$

where

$BTHS$ is total births,
BR_i is the birth rate for women in age group i, and
P_{i2} is the total number of women in age group i.

Note that the births are calculated only for the m child bearing age groups (usually age 10 to 49) and not the n total age groups in the population. Male births and female births are calculated as a proportion of total births.

$$MBTHS = kBTHS$$
$$FBTHS = (1.0 - k)\ BTHS$$

where

$MBTHS$ is male births,
$FBTHS$ is female births, and
k is a constant estimated from historical data.

Deaths may be calculated as a function of the total population of each age, sex group, and the death rate for that particular group. Deaths would be calculated as:

$$MBDTHS = MBTHS \cdot MBDR$$
$$FBTHS = FBTHS \cdot FBDR$$
$$DTHS_{ij} = P_{ij} \cdot DR_{ij}$$
$$TDTHS = MDBTHS + FBDTHS = \sum_{i=1}^{2} DTHS_{ij} \quad (i=1,\ 2,\ 3......n)$$

where

$MBDTHS$ is male birth deaths,
$MBDR$ is male birth death rate,
$FBDTHS$ is female birth deaths,
$FBDR$ is female birth death rate,
$DTHS_{ij}$ is deaths age group i, sex j,

DR_{ij} is death rate age i, sex j, and
TDTHS is total deaths.

The process of aging is also included in the cohort-survival model. If we survive each component of the original population (i.e., remove the deaths), we have in a sense already aged that group. However, since the size of each age group has changed through time, some further calculations are necessary to determine the size of each new component.

Since the most common procedure for deomgraphic models utilizes five year age intervals, a five-year projection period would require that each age sex group be advanced by one age group to account for the aging process. Note that the survivors of births during the intervening period now constitute the age group 0-4 years. Since the original terminal age group was not advanced, the new terminal group is now composed of survivors from last period's terminal group and also the survivors from last period's next to last age group. Annual projections, though somewhat less precise, could be approximated in a similar manner.

Estimating migration

As would be expected, the cohort-survival technique yields excellent results, if there is no significant migration expected to occur into or out of the area for which the projection is being made. This no-migration assumption is clearly not applicable to most small areas. A basic limitation of the cohort-survival model for projecting population is that there is no mechanism within the model structure itself, which relates the level or composition of migrants to the expected or projected economic activity. The usual practice when using this type of analysis is to extrapolate age and sex specific migration rates from a previous time into the future. For example, a net migration rate may be calculated from a previous time period and applied to a base year population to arrive at some future migration estimate.

To some extent, this approach does relate projected migration to changes in the area's economic activity; however, it implicitly assumes that changes in the level and structure of economic activity in a previous time period are similar to the economic changes expected in the projected period. Thus, the problem of projecting migration is central to the problem of population projection for most areas.

Recent work by the San Diego County Comprehensive Planning Organization (1972), Hachman (1972), and Monarchi (1974) suggests a possible framework for linking new employment opportunities and migration estimation. The basic approach used in these models is to assume an exogenous migration component and an endogenous migration component, which are related to projected changes in the region's total employment and to the available labor supply in the region.

The exogenous migration component may be composed of retirement migration, military related migration, or perhaps college student migration. It is likely that this component will be small for most areas, and, for the most part, a subjective estimation will suffice. This estimated component will, of course, include not only the retirees, the military personnel, and college students, but also the dependents of these migrants. (For the study area, all non-employment related migration was assumed to be retirement-related, and no dependents were included for this component.) The employment related migrants will also include dependents.

Assuming that for some time (t + θ) we have a projected total employment (from the employment model outlined earlier), and a projected unemployment rate for a region, the task then is to estimate the net employment - related migration which can be expected for the region between time (t) and (t + θ). Using the cohort-survival model, an estimate of the total population by age and sex for (t + θ) can be made, which projects the population that would occur, if there were no migration (not zero net migration , but zero migration). With the addition of the exogenous migration component, the total population would be given by:

$$TROP(t + \theta) = \sum_{i=1}^{n} (P_{ij}(t + \theta) + NEM_{ij})$$

where

$TPOP$ and P_{ij} are as before, and
NEM_{ij} is the non-employment related migration.
This total population may be subdivided into a total labor force,
This total population may be subdivided into a total labor force,
employed workers, and unemployed workers:

$$TLAB = \Sigma(LFPR_{ij} \cdot P_{ij})$$

$$TEMP = TLAB \cdot (1.0-UR)$$

$$TUEMP = TLAB - TEMP$$

where

$TLAB$ is the labor force,
$LFPR_{ij}$ is the labor force participation rate for the group ij,
$TEMP$ is total calculated employment,
UR is the projected unemployment rate, and
$TUEMP$ is total calculated employment.

In the highly unlikely event that the total calculated employment (TEMP) from this procedure is exactly equal to the projected total employment, the net employment related migration for this period would be exactly zero. In this case the projected total population would be:

$$TPOP\ (t + \theta) = \sum_{i=1}^{n} (P_{ij}\ (t + \theta) + NEM_{ij} + EM_{ij})$$

where

P_{ij} $(t + \theta)$ is the projected population from the cohort-survival model.

NEM_{ij} is the exogenous non-employment migration, and
EM_{ij} is the employment-related migration (zero).

This projected population would be completely consistent with the projected total employment and the projected unemployment for the area.

What is far more likely, of course, is that the calculated employment (TEMP) is not equal to the projected employment, and, consequently , ome employment migration must occur in order to balance the available supply of labor and the projected demand. If the two are different, and if the calculated employment is greater than the total projected employment, then we must conclude that some net employment related out-migration must have occurred between time (t) and (t + θ). On the other hand, if the projected employment is greater than the calculated employment, then we must conclude that net employment related in-migration must have taken place.

If we can assume or estimate a distribution, a labor force participation rate, and an unemployment rate for the employment-related migrants, then an estimate of the age and sex totals of migrants, and for the projected total population can be prepared. The estimation procedure would be:

$$TEM = (TPEMP - TEMP) \cdot \{(1.0 + UR) \cdot \sum_{i=1}^{n} (DM_{ij} \cdot LFPR_{ij})\}$$

$$EM_{ij} = DM_{ij} \cdot TEM$$

$$P_{ij}(t + \theta) = P_{ij}(t + \theta)\ NEM_{ij} + EM_{ij}$$

$$TROP(t + \theta) = \sum_{i=1}^{n} P_{ij}(t + \theta)$$

$$TLAB = \sum_{i=1}^{n} LFPR_{ij} \cdot P_{ij}(t + \theta)$$

$$TEMP = TLAB \cdot (1.0 - UR)$$

$$TUEMP = TLAB - TEMP$$

where

ΣDM_{ij} (migrant distribution) equals 1.0,
TEM is total employment related migrants, and

TPEMP is total projected employment.

The estimated total population for time $(t + \theta)$ is consistent with the projected total employment and the projected unemployment. If we assume that in- and out-migrants move on the very last day of the time period, then the total population estimate is completely consistent with the projected employment and unemployment. If we apply this condition, then the projected labor supply is now exactly equal to the projected labor demand for the area. Utilizing this procedure, we can now approximate the changes that occur in a regional population system as a result of natural increases and decreases, and the migration which occurs as a result of the interaction between the natural population forces and changes in the levels of economic activity in the region.

Allocation of Project Employment to Place of Residence

The primary data inputs for the population-employment model are the projected levels of employment for the basic industries, and the export-oriented employment for business-serving and population-serving industries. In addition to a trend element which is included for each of these industries, the projected employment for the basic industries also includes employee requirements for approximately twenty-five water and energy-related developments in the immediate study area. These future employee requirements were estimated on an annual basis for the period 1975-1990; they are based largely upon personal interviews and recent published literature.

In order to examine some of the possible impacts associated with the additional employment anticipated for these individual projects, a straightforward gravity type model was devised as a means of allocation project or direct employment among the existing communities in the study area. Since most of the actual projects are located in remote areas of the region, the allocation of direct employment to place of residence is a necessity. Given the community allocations, county level totals were calculated, and these direct employee estimates were used as data inputs for the population-employment model. Depending upon the estimated propensity to import (as specified by the employment coefficients), the county will experience multiplier effects from these resident employees, even though the place of employment may be outside that county. The general form and description of the gravity model is outlined hereafter.

The gravity model

After each project site was located, the distance in miles to each plausible community of residence was calculated. While it is recognized that many persons may choose to locate outside established communities, these cities and towns will undoubtedly continue to serve as "activity centers" for the region. The allocation to communities does not imply that all of the employees will reside inside the cities and towns. Since many of the developments occur in areas of limited access, all distance estimates were made for both primary and secondary type road surfaces.

All mileage estimates were then converted to a time basis, using a travel time of 40 mph for secondary surfaces, and 55 mph for primary routes. In cases where several alternative routes to a community were possible, only the one with the lowest travel time was considered with the others ignored. A maximum one-way travel time of one hour was used to further delimit the possible community area.

The actual employment allocations were then made, based upon a computed attraction index with the attraction inversely related to the time factor (distance) and directly related to the community population. The attraction index is calculated as:

$$A_i = \frac{P_1}{T_{i1}} + \frac{P_2}{T_{i2}} + \frac{P_3}{T_{i3}} + \frac{P_n}{T_{in}} = \sum_{j=1}^{n} \frac{P_j}{T_{ij}}$$

where

A_i is the attraction index for project i,
P_1, P_2, P_3, P_n is the population for communities 1, 2, 3, n, and
T_{i1}, T_{i2}, T_{i3}, T_{in} is the travel time for project i to each community.

The allocation to each community is proportional to each community so that:

$$AE_{i1} = \left(\frac{P_1}{T_{i1}} \Big/ \sum_{j=1}^{n} \frac{P_j}{T_{ij}} \right) \cdot TE_i$$

where

AE_{i1} is the allocated employment from project i to community 1, and
TE_i is the total annual employment for project i.

The attraction index was updated periodically with new population estimates for the communities. The base year was 1974 with that index used for 1975-76; 1976 was used for 1977-78; 1978 was used for 1979-80; 1980 was used for 1981-83; 1983 was used for 1984-85; and the 1985 index was used for 1986-1990. Because of the great variations in some project employment, some adjustments to the allocation were necessary. For example, because of the magnitude of some projects, employees allocated to a community in one time period from a single project might be allocated to a different community in a succeeding period. This was deemed inappropriate, and individual adjustments were made in the allocations to insure that no reductions in allocated employment from a single project would occur, unless the total project employment was declining. For most instances then, once a particular project employee is allocated to a community, he remains in that community for the life of the project, or until that project employment is reduced or eliminated.

TABLE XI-3

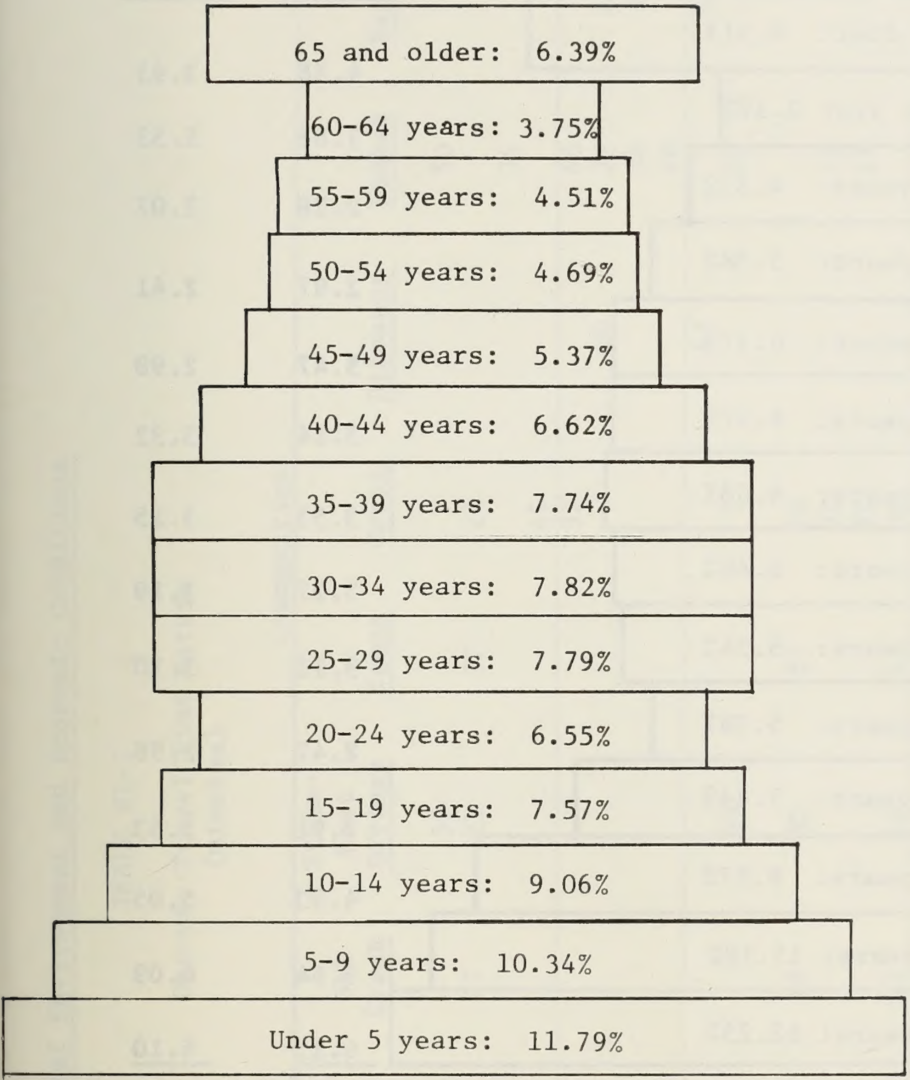
SURVIVAL RATES

Age Group	1970 Male	1970 Female	1990 Series E Male	1990 Series E Female
0- 4	.99417	.99601	.99944	.99956
5- 9	.99952	.99967	.99959	.99973
10-14	.99943	.99982	.99919	.99963
15-19	.99854	.99930	.99848	.99944
20-24	.99816	.99917	.99830	.99931
25-29	.99813	.99918	.99828	.99908
30-34	.99817	.99887	.99782	.99869
35-39	.99709	.99859	.99673	.99805
40-44	.99571	.99773	.99481	.99706
45-49	.99344	.99660	.99157	.99556
50-54	.99085	.99531	.98695	.99353
55-59	.98500	.99270	.98005	.99012
60-64	.97706	.98908	.97012	.98456
65-69	.96391	.98254	.95650	.97553
70-Over	.91390	.93758	.90420	.92038

TABLE XI-4

BIRTH RATES

Age of Mother	1970	1990 Series E
10-14	.00041	.0006
15-19	.06662	.0538
20-24	.16340	.1531
25-29	.14161	.1253
30-34	.06554	.0607
35-39	.02544	.0224
40-44	.00671	.0052
45-49	.00037	.0003

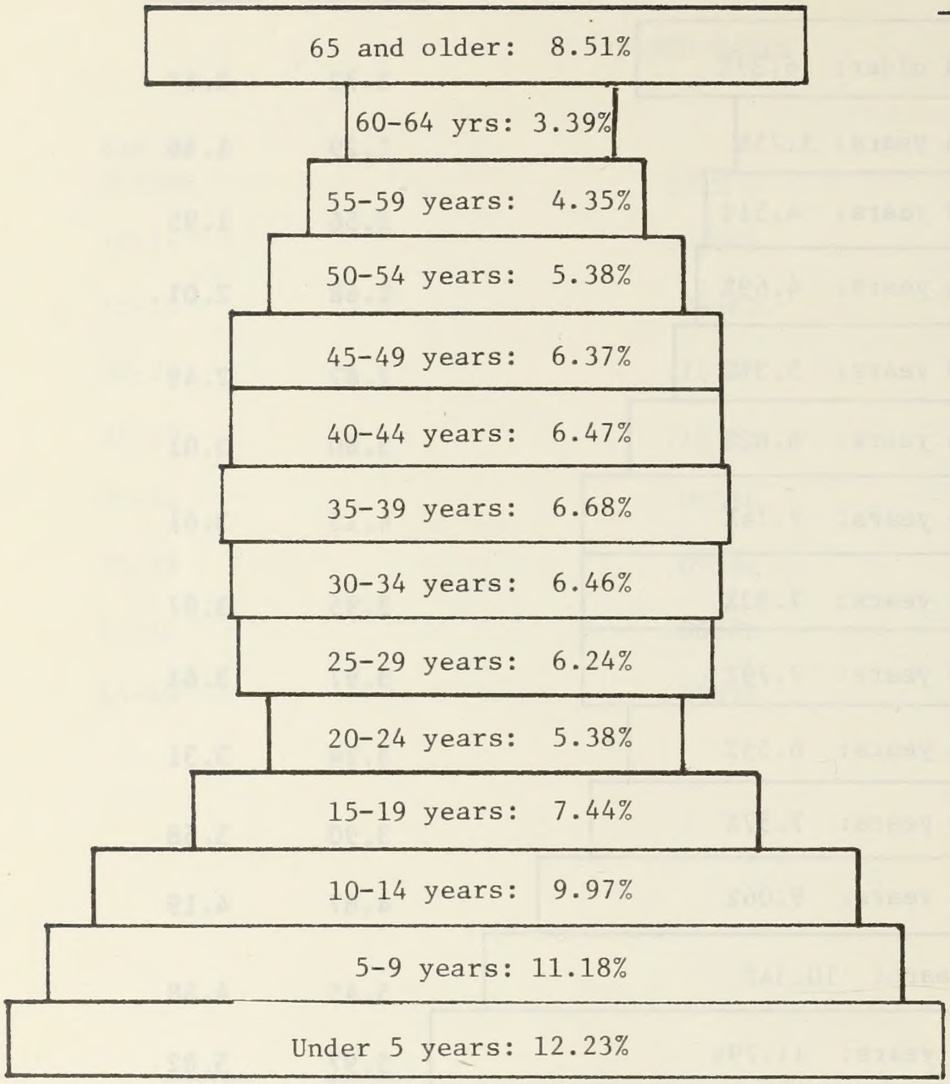


	Percent Male	Percent Female
65 and older: 6.39%	3.72	2.67
60-64 years: 3.75%	2.29	1.46
55-59 years: 4.51%	2.56	1.95
50-54 years: 4.69%	2.68	2.01
45-49 years: 5.37%	2.87	2.49
40-44 years: 6.62%	3.60	3.01
35-39 years: 7.74%	4.13	3.61
30-34 years: 7.82%	3.95	3.87
25-29 years: 7.79%	3.97	3.82
20-24 years: 6.55%	3.24	3.31
15-19 years: 7.57%	3.90	3.68
10-14 years: 9.06%	4.87	4.19
5-9 years: 10.34%	5.45	4.88
Under 5 years: 11.79%	5.97	5.82
Total Population: 19,605	52.23	46.77

Note: Percentage data does not add to 100% due to rounding.

Figure XI-1

1950 age distribution: three county region.



	Percent Male	Percent Female
65 and older: 8.51%	4.58	3.93
60-64 yrs: 3.39%	1.83	1.53
55-59 years: 4.35%	2.28	2.07
50-54 years: 5.38%	2.97	2.41
45-49 years: 6.37%	3.47	2.90
40-44 years: 6.47%	3.14	3.32
35-39 years: 6.68%	3.53	3.15
30-34 years: 6.46%	3.27	3.19
25-29 years: 6.24%	3.15	3.10
20-24 years: 5.38%	2.42	2.96
15-19 years: 7.44%	3.91	3.53
10-14 years: 9.97%	4.93	5.05
5-9 years: 11.18%	5.64	6.09
Under 5 years: 12.23%	6.13	6.10
Total Population: 18,111	51.23	48.77

Figure XI-2

1960 age distribution: three county region.

TABLE XI-5

One-way Travel Time Matrix
(minutes)

	Communities							
Projects	Hayden	Oak Creek	Steam-boat Springs	Yampa	Craig	Dinosaur	Meeker	Rangely
Yampa Project	26		53		7		50	
Hayden Expansion	5	47	23	57	24			
Yellow Jacket							34	
Savory Pot-Hook	60				41			
Cross Mtn.-Juniper	51				32		60	
Superior						60	23	44
Ca-							36	55
Cb-							48	
Ua-Ub						43		62
Craig Mine	26		53		7		50	
Energy Fuels	29	15	30	25	58			
Colowyo	49				31		21	
Grace R. R.	49				31		21	
Seneca 2-W	17	53	44	63	36			
Ruby Construction	27	42	54	52	46			
Thomas Woodward	17	32	15	42	36			
Merchants Petroleum								
Midland Coal								
Paul Coupey								
Consolidation Coal	61				43		11	
AEP	20		47		26			
Coal Fuels	6	57	33		22			
Moonlake						24	58	16
Empire Energy	30		57		11		47	
UI: Danforth								
Craig 3, 4	26		53		7		50	

TABLE XI-6

Direct Employment Matrix

(Construction / Permanent)

	1975	1976	1977	1978	1979	1980	1981	1982
Base Scenario:								
Yampa Project	335 /	1,357 /	1,158 / 36	559 / 72	/ 110	/ 110	/ 110	/ 110
Hayden Expansion	350 / 25	/ 35	/ 35	/ 35	/ 35	/ 35	/ 35	/ 35
Yellow Jacket					370 /	370 /	370 /	370 /
Savory Pot-Hook	250 /	250 /	250 /	250 /	250 /	/ 10	/ 10	/ 10
Cross Mtn.-Juniper						380 /	380 /	380 /
Craig Mine	/ 39	20 / 50	51 / 100	0 / 151	/ 165	/ 165	/ 165	/ 165
Oil Shale	35 /	460 /	700 /	1,165 /	700 / 150	710 / 750	2,390 / 900	3,850 / 1,100
Site Specific Scenarios:								
Energy Fuels		90 / 18	/ 39	/ 85	/ 110	/ 137	/ 166	/ 198
Colowyo		100 / 124	100 / 174	/ 210	/ 244	/ 244	/ 244	/ 244
Grace R. R.		100 /	100 /	110 / 14	/ 29	/ 29	/ 29	/ 29
Seneca 2-W		61 /	/ 44	/ 44	/ 44	/ 44	/ 44	/ 44
Ruby Construction		/ 65	/ 65	/ 65	/ 65	/ 65	/ 65	/ 65
Regional Scenario:								
AEP			/ 75	/ 110	/ 150	/ 210	/ 275	/ 275
Coal Fuels			/ 290	/ 290	/ 290	/ 290	/ 290	/ 290
Moonlake Electric			200 /	400 /	800 /	1,400 /	1,800 / 376	1,600 / 412
Empire Energy			/ 78	/ 78	/ 78	/ 78	/ 78	/ 78
Craig 3, 4					950 /	811 / 23	391 / 46	/ 70
Other Coal Mines						/ 575	/ 575	/ 575

Note: These data are over and above any employment levels as of 7/75.

TABLE XI-6 (Cont.)

Direct Employment Matrix

(Construction / Permanent)

	1983	1984	1985	1986	1987	1988	1989	1990
Base Scenario:								
Yampa Project	/ 110	/ 110	/ 110	/ 110	/ 110	/ 110	/ 110	/ 110
Hayden Expansion	/ 35	/ 35	/ 35	/ 35	/ 35	/ 35	/ 35	/ 35
Yellow Jacket	370 /	/ 10	/ 10	/ 10	/ 10	/ 10	/ 10	/ 10
Savory Pot-Hook	/ 10	/ 10	/ 10	/ 10	/ 10	/ 10	/ 10	/ 10
Cross Mtn.-Juniper	380 /	380 /	/ 10	/ 10	/ 10	/ 10	/ 10	/ 10
Craig Mine	/ 165	/ 165	/ 165	/ 165	/ 165	/ 165	/ 165	/ 165
Oil Shale	3,850 / 1,110	3,000 / 2,305	1,000 / 3,380	600 / 3,668	/ 4,090	/ 4,113	/ 4,135	/ 4,135
Site Specific Scenarios:								
Energy Fuels	/ 233	/ 268	/ 306	/ 326	/ 346	/ 369	/ 393	/ 418
Colowyo	/ 244	/ 244	/ 244	/ 244	/ 244	/ 244	/ 244	/ 244
Grace R. R.	/ 29	/ 29	/ 29	/ 29	/ 29	/ 29	/ 29	/ 29
Seneca 2-W	/ 44	/ 44	/ 44	/ 44	/ 44	/ 44	/ 44	/ 44
Ruby Construction	/ 65	/ 65	/ 65	/ 65	/ 65	/ 65	/ 65	/ 65
Regional Scenario:								
AEP	/ 275	/ 275	/ 275	/ 275	/ 275	/ 275	/ 275	/ 275
Coal Fuels	/ 290	/ 290	/ 290	/ 290	/ 290	/ 290	/ 290	/ 290
Moonlake Electric	1,400 / 445	800 / 445	400 / 485	600 / 532	600 / 564	/ 571	/ 672	/ 746
Empire Energy	/ 78	/ 78	/ 78	/ 78	/ 78	/ 78	/ 78	/ 78
Craig 3, 4	/ 70	/ 70	/ 70	/ 70	/ 70	/ 70	/ 70	/ 70
Other Coal Mines	/ 575	/ 575	/ 575	/ 575	/ 575	/ 575	/ 575	/ 575

Note: These data are over and above any employment levels as of 7/75.

TABLE XI-7

Moffat County Population Projection

	Craig			Dinosaur			County Total		
Year	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative
1975	8006	0	8006	300	0	300	9001	0	9001
1976	10853	1143	11996	307	0	307	11872	1143	13015
1977	10539	2084	12623	351	36	387	11621	2120	13741
1978	8918	2090	11008	394	72	466	10064	2161	12225
1979	7859	5098	12927	392	149	541	9026	5217	14243
1980	8945	4776	13721	408	252	660	10154	5028	15182
1981	9133	4366	13499	431	368	799	10392	4734	15126
1982	9429	3331	12760	581	342	923	10870	3673	14543
1983	9721	3499	13220	807	322	1129	11421	3821	15242
1984	10025	3595	13620	1133	233	1366	12087	3828	15915
1985	9320	3716	13036	947	174	1121	11234	3890	15124
1986	9744	3782	13526	921	193	1114	11674	3975	15649
1987	10119	3836	13955	915	217	1132	12086	4053	16139
1988	10516	3897	14413	935	89	1024	12549	3986	16535
1989	10932	3956	14888	955	111	1066	13035	4068	17103
1990	11373	4002	15375	975	126	1101	13547	4128	17675

Notes:

"Base" is the base scenario population projection; it is a forecast of population without coal-related development. County total includes growth in rural areas.

"Δ Cum." is the incremental population growth over and above the Base that is associated with the proposed Federal action.

"Cumulative" is the sum of the Base and Δ Cum. and is the forecast of total population with coal-related development.

TABLE XI-8

Rio Blanco County Population Projection

	Meeker			Rangely			County Total		
Year	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative
1975	1809	0	1809	1705	0	1705	5431	0	5431
1976	2613	356	2969	1736	0	1736	6300	356	6656
1977	3389	550	3939	1919	316	2235	7300	867	8167
1978	4488	634	5122	2103	622	2725	8629	1255	9884
1979	5280	1157	6437	2130	1254	3384	9499	2410	11909
1980	5672	1607	7279	3356	2195	5551	11171	3803	14974
1981	7416	3180	10596	6398	3767	10165	16021	6947	22968
1982	8874	2988	11862	9125	3416	12541	20275	6405	26680
1983	8274	2911	11185	8878	3121	11999	19501	6032	25533
1984	6604	2633	9237	9033	1830	10863	18065	4462	22527
1985	6629	2468	9097	7838	924	8762	16978	3392	20370
1986	7209	2647	9856	7664	1466	9130	17470	4114	21584
1987	6924	2677	9601	7614	1541	9155	17230	4218	21448
1988	7077	2155	9232	7793	841	8634	17661	2996	20657
1989	7223	2293	9516	7959	1007	8966	18077	3300	21377
1990	7353	2372	9725	8094	1112	9206	18541	3484	21935

Notes:

"Base" is the base scenario population projection; it is a forecast of population without coal-related development. County total includes growth in rural areas.

"Δ Cum." is the incremental population growth over and above the Base that is associated with the proposed Federal action.

"Cumulative" is the sum of the Base and Δ Cum. and is the forecast of total population with coal-related development.

TABLE XI-9

Routt County Population Projection

	Hayden			Oak Creek			Steamboat Springs		
Year	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative
1975	1839	0	1839	1286	0	1286	5853	0	5853
1976	1709	212	1921	1372	116	1488	6378	286	6664
1977	1861	509	2370	1498	97	1595	6902	556	7458
1978	1958	521	2479	1623	120	1743	7316	492	7808
1979	1966	678	2645	1745	137	1882	7545	761	8306
1980	2212	727	2939	1868	172	2040	8089	924	9013
1981	2296	788	3084	1940	190	2130	8396	918	9314
1982	2383	752	3135	2011	210	2221	8704	855	9559
1983	2468	776	3244	2082	227	2309	9010	898	9908
1984	2551	796	3347	2153	248	2401	9316	937	10253
1985	2517	826	3343	2224	272	2496	9627	971	10598
1986	2524	837	3361	2237	286	2523	9683	995	10678
1987	2527	850	3377	2250	299	2549	9737	1020	10757
1988	2529	867	3396	2262	315	2577	9787	1049	10836
1989	2531	882	3413	2274	331	2605	9832	1076	10908
1990	2533	896	3429	2287	348	2635	9885	1107	10992

Notes:

"Base" is the base scenario population projection; it is a forecast of population without coal-related development.

"Δ Cum." is the incremental population growth over and above the Base that is associated with coal-related development.

"Cumulative" is the sum of the Base and Δ Cum. and is the forecast of total population with coal-related development.

TABLE XI-9 (Cont.)

Routt County Population Projection

	Yampa			County Total		
Year	Base	Δ Cum.	Cumulative	Base	Δ Cum.	Cumulative
1975	357	0	357	11084	0	11434
1976	354	43	397	11589	655	12594
1977	366	33	399	12435	1195	13980
1978	379	39	418	13115	1174	14639
1979	393	43	436	13527	1620	15497
1980	408	51	459	14492	1874	16716
1981	425	55	480	15012	1951	17313
1982	442	63	505	15541	1880	17771
1983	460	71	531	16066	1972	18388
1984	479	79	558	16591	2059	19000
1985	498	87	585	17005	2155	19510
1986	517	91	608	17150	2209	19709
1987	537	96	633	17289	2265	19904
1988	558	100	658	17427	2330	20107
1989	579	104	683	17565	2393	20308
1990	600	108	708	17704	2458	20512

Notes:

"Base" is the base scenario population projection; it is a forecast of population without coal-related development. County totals include growth in rural areas.
"Δ Cum." is the incremental population growth over and above the Base that is associated with the proposed Federal action.

"Cumulative" is the sum of the Base and Δ Cum. and is the forecast of total population with coal-related development.

CRAIG OPINION SURVEY QUESTIONNAIRE

and

MEEKER OPINION SURVEY QUESTIONNAIRE

CRAIG DEVELOPMENT STUDY

FIRST, we would like to ask some questions about the whole issue of growth, especially as it might occur in the Craig area.

1. The population of Craig is currently around 6000 people. What is the largest number of people you would want to see living here ten years from now? ______
____

2. Moffat County presently has about 9000 people. What is the largest number of people you would want to see living in the county ten years from now? ______
____

3. Would you want to see growth occur around here if it were only for a short time, followed by a drop again? ___Yes ___Unsure ___No

4. Do you feel the pace of growth in Craig has been...
___Too slow ___About right ___Too fast

5. What do you see as the costs of growth for Craig? ______
____
____

6. What do you see as the benefits of growth for Craig? ______
____
____

7. To your way of thinking, are the costs you outlined...
___More than the benefits
___About equal to the benefits
___Less than the benefits
___No opinion/unsure

8. Of the groups I read off, which should be the main one to pay for growth?
___New industry ___Incoming population ___Merchants
___Existing population ___Developers ___Other (______)

9. Which should be the last one to pay for growth?
___New industry ___Incoming population ___Merchants
___Existing population ___Developers ___Other (______)

10. Can you identify any group within the population that would be most hurt by growth? ______________________________
In what way? ______________________________
____

11. Can you identify any group within the population that would be most benefited by growth? ______________________________
In what way? ______________________________
____

12. Has planning for growth in Craig been...
a. ___Handled very well ___Handled okay ___Handled poorly
b. ___Too little ___About right ___Too much
c. ___Even-handed ___Favorable to a few

SOURCE: SOCIAL CHANGES SYSTEMS

13. Should Craig engage in any further annexation? ___Yes ___Unsure ___No

If YES, under what conditions or for what reasons? ____________________

____

If NO, why not? ____________________

____

14. Can you tell where Craig begins and ends now? ___Yes ___Unsure ___No

15. How important is that to you?
___Very imp. ___Imp. ___Unsure ___Unimp. ___Very unimp.

16. Do you think that increased mining or a power plant operation will have...
___A positive effect on the natural environment
___No effect on the natural environment
___A negative effect on the natural environment

In what way? ____________________

17. What situation /event/person currently presents the biggest threat to the natural environment around here? ____________________

____

18. What aspects of the physical appearance of Craig would be...

Helped as a result of growth ____________________

Worsened as a result of growth ____________________

NEXT, we have some questions about where exactly growth might take place in the Craig area.

1. If growth is to occur in this region as part of increased mining activity or power plant construction, where should that growth occur?
___In and around existing communities primarily
___In a new town primarily
___In a new town as well as in and around existing communities

2. Would you want to see growth occur in or around any of these following towns?

	Yes	Unsure	No		Yes	Unsure	No
Craig	1	2	3	Rangely	1	2	3
Steamboat Springs	1	2	3	Hayden	1	2	3
Rifle	1	2	3	Axial	1	2	3
Meeker	1	2	3	Maybell	1	2	3

3. If there is to be a new townfor a mine or power plant, should it be located...
___Near Craig
___Near the mine or power plant

4. If a new town were to develop near Craig, how close would you want it to be to Craig?
___Closer than 5 miles
___6-25 miles away
___26-50 miles away
___More than 50 miles away

5. Of the possible growth sites on this map, which one do you feel would be best for a new town of several thousand people, and why? Which one would be worst for a new town, and why?

Best: ______ ____________________

____

Worst: _____ ____

____

GROWTH can change the life of a community in many cases. Let's talk about what you see possibly happening in Craig.

1. Many communities have some basic lines along which the population is divided; maybe it's the whites vs. the non-whites, or the people on the hill vs. the people in the valley, etc. What are the most important lines along which the population of Craig is divided? ______________________________

____

2. Sometimes when a community grows in population, it becomes harder to know a lot of people.

	Yes	Unsure	No
Have you experienced this in Craig already?	1	2	3
Do you think this would happen if the population grew from 6000 to 20,000 + in ten years?	1	2	3
From 6000 to 15,000 in ten years?	1	2	3
From 6000 to 10,000 in ten years?	1	2	3

3. What kind of sense of community do you feel Craig now has?
   ___Strong sense of community
   ___Adequate/so-so
   ___Weak sense of community
   ___No opinion/unsure

4. Generally when a community gets larger, the variety of people becomes wider. How would you regard this if it were to happen in Craig?
   ___Good for the town
   ___Good & bad for town
   ___Bad for the town
   ___No opinion/unsure

5. Can you think of any social conflicts here that would be heightened/made worse by growth? ______________________________

____

6. Can you think of any social conflicts here that would be lessened/decreased by growth? ______________________________

____

7. Do you see any problem for newcomers in adjusting to Craig?
   ___Yes ___Unsure ___No

8. Do newcomers seem to be welcomed by the community?
   ___Yes ___Unsure ___No

9. If the town's population were to grow, could you imagine a situation where...

	Yes	Unsure	No
There are too many people to fill the available community leadership positions	1	2	3
There are too many new positions of community leadership created & not enough people to fill them	1	2	3

GROWTH can also have effects on things like the economy, government, schools, and so forth. We have a few questions about your views on those situations.

1. Do you see that growth would have any impact on the business community here?
___Good ___Mixed ___Bad ___No opinion/unsure

Explain ______________________________

____

2. Do you think growth would have any economic or financial impact upon you personally? ___Good ___Mixed ___Bad ___No opinion/unsure

Explain ______________________________

____

3. Would the school system be benefited or hurt by population growth in Craig?
___Benefited ___Mixed consequences ___Hurt ___Unsure/no opin.

In what ways? ______________________________

4. Would increased population in Craig make local government more or less responsive, or have no impact on their responsiveness to the people?

	More	No diff	Less
Craig town council	1	2	3
County commissioners	1	2	3

5. What community facilities or services do you think would be most overburdened by growth? ______________________________

6. Which ones do you think would most likely get developed/improved in the wake of growth? ______________________________

NOW we need to know a few facts about you and your family to understand better your answers to the other questions.

1. What is your age? _____ Sex: F M Jt Ot Eth: An Bl Ch Or Ot

2. What is your marital status?
Married Single Separated Divorced Widowed Living Together

3 What is your spouse's age? ______

4. Do you have any children living at home? or any other persons?
Ages: ___ ___ ___ ___ ___ ___ ___ ___ Others: _____

5. How many years have you lived...
in Craig_____ in Moffat County_____ in Colorado_____

6. Do you have any plans to move soon? Yes Unsure No
If YES, why? ____

7. If you could not live in Craig, what would be your second choice of a place to live? ____________________

8. Do you own or rent this house? Own Rent
Type of dwelling: ___Single family ___Apartment ___Other
___Mobile home ___Motel (______________)

9. What is the highest level of formal education you completed?
- ___Under 7 years of school
- ___7 to 9 years of school
- ___10 to 11 years of school (part of high school)
- ___High school graduate
- ___1 to 4 years of college/business school (or AA degree but not bachelor's degree)
- ___4 year college graduate (bachelor's degree)
- ___Received professional degree (MA, MS, PhD, law degree, MD, etc.)

10. What is your present occupation? ______________________________

11. Your spouse's? ______________________________________

12. Where did you meet most of your friends, or people with whome you socialize most frequently, in Craig? (multiple answers if applicable)
- ___At work
- ___At church
- ___At clubs/community activities
- ___At recreational activities
- ___At local bars
- ___At neighbors
- ___Other (____________________)

13. In which of the following categories would your annual family income be?
- ___Under $4000
- ___$4000 - $6999
- ___$7000 - $9999
- ___$10,000 - $14,999
- ___$15,000 - $24,999
- ___$25,000 and over

14. Are there any other comments you would like to make?

CHARACTERISTICS OF THE SAMPLE
(Percentages)

Age

	Respondent	Spouse
Under 19	2.4	2.8
20 - 29	30.6	29.6
30 - 39	24.7	26.8
40 - 49	11.8	19.7
50 - 59	11.8	11.3
60 - 64	8.2	2.8
65 and over	10.4	7.0

	Respondent	Spouse
Under 30	33.0	32.4
30 - 49	36.5	46.5
50 and over	30.4	21.1

Sex

Female	66.7
Male	24.1
Joint	9.2

Ethnicity

Anglo	90.8
Chicano	5.7
No Response	3.4

TOTAL RESPONSES: 87

Marital Status

Married	80.5
Single	6.9
Separated	3.4
Divorced	1.1
Widowed	6.9
No Response	1.1

Children at home

None	37.9
1	17.2
2	27.6
3	12.6
4	2.3
5	2.3

Family Life Cycle Stage

Pre-child	9.2	35.6
Child-bearing	26.4	
Child-rearing	25.3	32.2
Child-launching	6.9	
Post-child	2.3	32.1
Older, childless	21.8	
Widow/widower	8.0	

Years in Craig/Moffat County/Colorado

	Craig	County	State
Less than 1 year	22.1	20.0	7.1
1.0 - 2.9 years	9.3	9.4	9.4
3.0 - 4.9 years	3.5	3.5	3.5
5.0 - 6.9 years	5.8	5.9	1.2
7.0 - 8.9 years	3.5	3.5	1.2
9.0 - 10.9 years	4.7	3.5	2.4
11.0 - 19.9 years	15.1	11.8	14.1
20.0 or more years	36.0	42.4	61.2

Plans to move

Yes	5.7
Unsure	10.3
No	83.9

Reason for moving

Retiring	2.2
Weather	1.1
Other	1.1
No Response	1.1
Not App.	94.3

Second choice home

Western Colorado	33.3	48.0
Front Range Colorado	10.7	
Elsewhere Colorado	4.0	
Montana	9.3	
Other Western state	21.3	
Elsewhere USA	9.3	
Warmer climate	4.0	
Small community	2.7	
Other	5.3	

Own/Rent

Own	69.8
Rent	30.2

Type dwelling

Single family	73.6
Mobile home	14.9
Apartment	11.5

Formal education

Less than 7 years	2.3	58.0
7 - 9 years	8.1	
10 - 11 years	13.9	
High school graduate	33.7	
Some college	32.6	42.0
College graduate	3.5	
Professional degree	5.8	

Occupation

	Respondent	Spouse
Professional	10.3	8.0
Managerial	11.5	9.2
Sales	3.4	8.0
Clerical	4.6	2.3
Craftspeople	3.4	6.9
Operatives	-	1.1
Transportation operative	1.1	9.2
Laborers	6.9	11.5
Farm laborers	1.1	-
Service workers	5.7	10.3
Retired	9.2	3.4
Unemployed	2.3	-
Housespouse	37.9	10.3
No Response/Not Applicable	2.3	19.5

Socializing places (multiple responses allowed)

At work	54.0
At church	41.4
At clubs, etc.	36.8
At recreation	31.0
At local bars	4.6
At neighbors	49.4
Other	22.4

Family income

Under $4000	5.7	37.7
$4000 - 6999	8.0	
$7000 - 9999	24.1	
$10,000 - 14,999	31.0	
$15,000 - 24,999	14.9	19.5
$25,00 and over	4.6	
No Response	11.5	

AREA OPINION SURVEY
MEEKER, COLORADO

CONCERNS WITH JOBS FOR YOUTH

. . . . How Would You Rate:	Exc.	Good	Fair	Poor*
1. Local job opportunities for youth after graduation.				
2. Job opportunities for school age youth.				

* Please comment on back concerning "Poor" ratings.

CONCERNS WITH RECREATION

. . . . How Would You Rate:	Exc.	Good	Fair	Poor*
1. Recreational opportunities				
a. Children				
b. Youth				
c. Adults				
d. Senior citizens				

* Please comment on back concerning "Poor" ratings.

. . . . What About These Issues:	Yes	No
2. Should the old football field located between Sixth and Seventh Street and Hill and Cedar street be maintained as a public recreation area?		
3. Do you think the present Junior High would make a suitable city hall and recreation area if abandoned by the school district?		
4. Should Meeker provide an ice skating rink?		
5. Should Meeker provide expanded tennis courts?		

CONCERNS WITH PLANNING

. . . . How Would You Rate:	Exc.	Good	Fair	Poor*
1. Availability of adequate housing:				
a. Trailer space				
b. Apartments				
c. Houses for sale				
d. Houses for rent				
e. Vacant lots for building sites				

Please comment on back concerning "Poor" ratings.

SOURCE: MOFFAT COUNTY
PLANNING COMMISSION

CONCERNS WITH EDUCATION

. . . . How Would You Rate:	Exc.	Good	Fair	Poor*
1. Quality of educational programs				
a. Elementary school				
b. Junior high				
c. High school				
2. Availability of school facilities to the community.				
3. Responsiveness of public school personnel to peoples needs				
4. Responsiveness of school board to peoples needs.				

* Please comment on back concerning "Poor" ratings.

. . . . What About These Issues:	Yes	No
5. Do you feel the present junior high building should be replaced in the near future?		
6. If so, should the new junior high school be in a separate location from the high school?		
7. Do you think the Meeker school district citizens would pass a bond issue for a new junior high school in the near future?		
8. Would you vote in favor of a bond issue for a new junior high school in the near future?		
9. Do you think Meeker school district citizens would pass a bond issue for construction of school buildings for increased population caused by oil shale impact?		
10. Would you vote in favor of a bond issue for construction of school buildings for increased population caused by oil shale impact?		
11. Do you feel the high school library should be open to the public?		
12. Do you feel there are enough local informal educational opportunities available?		
13. Would you favor extending the Colorado Northwestern Community College (Rangely) School District to include Eastern Rio Blanco County?		

14. The maximum size of individual schools should be restricted to: (Circle one answer for each)

a. Elementary schools 300 400 500 Other_____(Specify)

b. Jr. High or Middle School 300 400 500 Other_____(Specify)

c. High schools 300 400 500 Other_____(Specify)

. . . . What About These Issues:	Yes	No
2. Do you feel that dilapidated and abandoned buildings in the town should be removed?		
3. Do you feel residential development should be limited to unproductive agriculture areas?		
4. Should the Town of Meeker's boundaries be expanded?		
5. If the results of a planning effort show that land use control is required, would you favor strong local authority?		

Scale—Strongly Agree, Agree, Disagree, Strongly Disagree.

	Strongly Agree	Agree	Dis-agree	Strongly Dis-agree
6. The majority of growth caused by the resource development should occur in Meeker.				
7. It is desirable that "new towns" be established to handle the resource development.				
8. We should let communities in Garfield County take the majority of the growth associated with the shale oil development.				
9. Developers should assume the total cost of new city services for their development.				
10. To provide adequate quality and quantity of water for domestic and fire protection, it is desirable to improve the facility through a bonding issue.				

Check your answer on each of the following:

11. With proper planning what percentage of the total housing would you find acceptable as mobile homes within the Meeker community? 20% 30% 40% 50% 60% 70%

12. How would you like to see the Meeker area grow? (Check one only)
   - a. ☐ As industrial and mining
   - b. ☐ As a recreation area
   - c. ☐ As a retirement area
   - d. ☐ As a combination of the above
   - e. ☐ Not at all

13. From the current population level of approximately 1700, to what amount would you like to see Meeker grow? (Check one only)
   - a. ☐ No growth
   - b. ☐ 3000 — 5000
   - c. ☐ 6000 — 10000
   - d. ☐ 10000 — 15000
   - e. ☐ Over 15000

CONCERNS WITH PUBLIC UTILITIES

. . . . How Would You Rate:	Exc.	Good	Fair	Po
1. Quality of water in Meeker				
2. Surface water drainage				

* Please comment on back concerning "Poor" ratings.

. . . . What About These Issues:	Yes	N
3. Are you aware that Meeker has a water pressure problem?		
4. Are you aware that adequate fire protection depends on water pressure zones in the city of Meeker?		
5. Are you aware of possible summer water rationing in Meeker?		
6. Should the residents of Meeker participate in a county-wide domestic water system?		
7. Should town services like sewer and water be extended beyond town limits?		
8. Are you willing to help share the cost of providing services for new growth?		

CONCERNS WITH BUSINESS ACTIVITIES

. . . . How Would You Rate:	Exc.	Good	Fair	Po
1. The attitude of local retailers toward customer service.				

* Please comment on back concerning "Poor" ratings.

. . . . What About These Issues?	Yes	N
2. Do you feel that the Meeker area should encourage new retail business enterprises?		
3. If you have a complaint about a consumer product or service do you know where to go for help?		

CONCERNS WITH HEALTH CARE

	Yes	N
1. Should Pioneers Hospital play a more active role in the community in providing for home health nursing?		
2. Alcoholism, by statute, is now considered a disease rather than a crime. Should the hospital use its facilities for the treatment of the alcoholic in cases where a crime is not involved?		
3. Should the nursing home be enlarged to provide more nursing home beds?		

CONCERNS WITH GOVERNMENT

. . . . How Would You Rate:	Exc.	Good	Fair	Poor*
1. Government response to community needs:				
a. Town officials				
b. Town planning and zoning				
c. County officials				
d. County planning and zoning				
e. State officials				
2. Street or highway maintenance?				
a. Town				
b. County				
c. State				
3. Fire protection and equipment				
4. Law enforcement and police protection				
a. City police				
b. Sheriff				

* Please comment on back concerning "Poor" ratings.

. . . . How About These:	Yes	No
5. Do you feel the community is run by and for a particular group of citizens? (If Yes, please specify the group on the comment page)		
6. Do you feel that the existing dog control ordinance should be strictly enforced?		

7. What are the two most important problems facing the Town of Meeker? (Please respond on the comment page.)

GENERAL INFORMATION

1. Sex
   - a. ☐ Male
   - b. ☐ Female
2. What is your principal occupation at the present time?
   - a. ☐ Retired
   - b. ☐ Student
   - c. ☐ Housewife
   - d. ☐ Farming or Ranching
   - e. ☐ Educator
   - f. ☐ Government
   - g. ☐ Business
   - h. ☐ Other________________(Please specify)
3. Circle last grade completed in school:

   Myself: less than 6, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

   Spouse: less than 6, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
4. Where do you live?
   - a. ☐ In town
   - b. ☐ Outside city limits
5. I presently:
   - a. ☐ Own a home
   - b. ☐ Lease
   - c. ☐ Rent a house
   - d. ☐ Rent an apartment
   - e. ☐ Other________________(Please specify)
6. Amount of land you own within the city limits of Meeker.
   - a. ☐ None
   - b. ☐ 1 Lot
   - c. ☐ 2-10 Lots
   - d. ☐ 1 or more acres
7. Number of housing units you own in Meeker.
   - a. ☐ None
   - b. ☐ 1 unit
   - c. ☐ 2-5 units
   - d. ☐ 5 or more units
8. Approximate annual income of your family last year.
   - a. ☐ Under $1000.00
   - b. ☐ $1001.00 — $4999.00
   - c. ☐ $5000.00 — $7999.00
   - d. ☐ $8000.00 — $12999.00
   - e. ☐ $13000.00 and over
9. Total of years you have lived in Meeker.
   - a. ☐ Under 1 year
   - b. ☐ 1— 5 years
   - c. ☐ 6—10 years
   - d. ☐ 11—20 years
   - e. ☐ over 20 years
10. If housing were available to suit your needs and budget, would you: (Check one)
    - a. ☐ Buy a new home
    - b. ☐ Buy an older home
    - c. ☐ Buy a new mobile home and put it on a lot of your own
    - d. ☐ Buy a new mobile home and put it on a modern mobile home park containing adequate open space and controls with enforcement
    - e. ☐ Move a mobile home from an existing location to a modern mobile home park containing adequate open space and controls with enforcement

	Yes	No
11. Are you registered to vote?		

COMMENT PAGE—If you came to the Meeker area within the last ten years, what three things most attracted you? (Please comment on reverse side.)

CHARACTERISTICS OF THE SAMPLE
(Percentage)

Sex

Male	56
Female	44

Occupation

Retired	23
Student	2
Housewife	17
Farming or Ranching	12
Educator	6
Government	8
Business	21
Other	10

Last Grade Completed in School

	Self	Spouse
Less than 6	a	a
6	a	0
7	a	0
8	5	6
9	3	2
10	3	5
11	5	3
12	32	38
13	10	11
14	10	10
15	5	3
16	12	13
17	13	8

[a] less than one percent

Location of Residence

In town	74
Outside City Limits	26

Own/Rent

Own a home	75
Lease	1
Rent a house	12
Rent an apartment	3
Other	9

Land Ownership within City Limits

None	37
1 lot	19
2-10 lots	41
1 or more acres	3

Number of Housing Units Owned in Meeker

None	51
1 unit	39
2-5 units	9
5 or more units	1

Annual Family Income

Under 1,000.00	3
\$ 1,001.00 - \$ 4,999.00	14
\$ 5,000.00 - \$ 7,999.00	19
\$ 8,000.00 - \$12,999.00	36
\$13,000 and over	28

Total Years Lived in Meeker

Under 1 year	7
1 - 5 years	17
6 - 10 years	10
11 - 20 years	11
Over 20 years.	55

If Housing Available to Suit Needs and Budget

Buy a new home	41
Buy an older home	34
Buy a new mobile home and put it on own lot	22
Buy a new mobile home and put in modern mobile home park	2
Move mobile home from existing location to modern mobile home park	12

Registered to Vote

Yes	92
No	8

* When the results were analyzed it was obvious that many of the respondents were confused as to how to fill out the questionnaire. The number of responses varied greatly between questions. For example, under general information, 325 responses were recorded to question one, and 359 to question eleven. Also, when respondents were asked to rate a number of items, the law of diminishing returns was realized. For example, in concerns with planning, question 2 had 351 responses, and question 5 only 240. Therefore, the results of this study should be taken with the ever popular grain of salt.

Bureau of Land Management Multiple Use Planning System

APPENDIX D
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FOR
BUREAU OF LAND MANAGEMENT
MULTIPLE USE PLANNING SYSTEM IN THE STUDY REGION

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Bureau of Land Management Multiple Use Planning System in the Study Region

General descriptions follow of: BLM's multiple use planning process, identification of status of planning in the study region, discussion of public participation in the planning process, and a description of the specific planning efforts involved in the identification of the 30 proposed coal lease offerings.

Resume of The Bureau's Planning System

Unit Resource Analysis - URA (BLM Manual 1605)

The URA is accomplished through four basic steps. The initial phase of the Bureau's planning system consists of compiling data pertaining to air, water, physical land, animal, vegetal, and mineral resources as well as use thereof. It is not intended to be an original inventory but rather a compilation and analysis of existing resource data for a common geographic unit - the Planning Unit. In some cases it is necessary to have a comparable data base for all resources, to obtain additional inventory data. The URA is not limited to written data sources, but in fact utilizes data from personal knowledge of resource personnel, other agencies, and the general public.

The four basic URA steps are:

Step I: Preparation of record keeping materials;

Step II: Commonly referred to as the physical profile: includes a description of the planning unit in terms of: climate, topography, geology and soils, vegetation, water resources, animals, fire, limiting physical factors, other limiting factors, and developments;

Step III: Analysis and recordation of present situation (i.e. use, problems, production, trends, quality for each of seven basic resource categories).

Step IV: Divided into two subparts:

1. Analysis and recordation of all technologically feasible management opportunities for each of the seven basic resource categories. This section will be as detailed and far-reaching as the basic data contained in Steps 2 & 3 will allow;

2. Analysis and recordation of all opportunities to improve ecological qualities, or stop or delay their degradation.

Socio-Economic Profile - SEP (BLM Manual 1606)

The SEP is an information document used to gather, organize, analyze, and record non-physical data required for the development of a Management Framework Plan. Information derived from the SEP is used primarily as input into the Planning Area Analysis to help evaluate the significance of resource values.

Planning Area Analysis - PAA (BLM Manual 1607)

The PAA analyzes social, economic, environmental, and institutional values of the resources within the planning area. PAA data are used to develop rational objectives and recommendations in Step I of the Management Framework Plan. The PAA also provides a data base to judge the significance of social, economic, institutional, and environmental values involved in the conflicts identified in Step 2 of the Management Framework Plan.

Management Framework Plans - MFP (Bureau Manual 1608)

The final phase of the Bureau's basic planning system provides direction for resource allocations for a specific planning area (may include two or more planning units). It also establishes objectives and constraints for each resource and support activity, as well as providing data for consideration in program planning.

The three basic steps through which the MFP is accomplished are:

Step I - Activity Objectives and Single-Resource Recommendations: Each resource specialist reviews and analyzes National Policies and Guidance, Planning Area Analysis, and URA Step 4 Opportunities. Based upon these reviews, activity objectives and rationales are developed and recorded by resource without considering other activity programs or values;

Step II - Multiple Use Analysis: The Area Manager analyzes the economic, social, institutional, and environmental factors to resolve conflicts between single-resource activity recommendations. These analyzes include alternatives and provide the District Manager with detailed information on which to base his recommendation;

Step III - Management Recommendation Process: The District Manager uses the data from Step II to reach and record his suggested management direction for each activity program within the Planning Area. Activity overlays depicting suggested management direction are prepared, and accompanying narrative analyses are publicized. With the completion of MFP Step 3, the Bureau's Basic Planning Phase is completed. The recommendations made in this final step are later developed into specific on-site Activity Plans. It is at this level that a final decision is made and on-the-ground action occurs.

It must be noted that this Planning System is dynamic; and as such, is subject to periodic revision and updating when new information becomes available.

Public Participation in the Bureau's Planning System

The Public is involved throughout the planning process. Public inclusion is similar in each planning effort; however, the amount of actual involvement appears to be determined by the degree of controversy generated by the resources contained within the individual planning areas.

Public participation in the Bureau's planning system can be summarized as:

Phase I: Keeping the public informed of BLM activities;
Phase II: Collecting and incorporating public knowledge and desires into the multiple-use planning process;
Phase III: Feedback indicating how public input was handled in MFP Step III.

Status of MFPs in the Study Region

Williams Fork MFP

The Williams Fork MFP was started in September 1973 and completed in June 1974. The planning effort covered all of Routt County and the eastern one-third of Moffat County, covering 1,496,000 acres of private (1,241,000 acres), State (96,000), and Federal (145,000 acres) surfaces. Total Federal mineral estate within the unit is 1,200,000 acres.

Vermillion MFP

The Vermillion MFP was completed in June 1973. This is a "first generation" plan completed under the 1971 Planning System manual, and is not to the quality standards required by the current manual; specifically, this MFP proposed no coal lease offerings. The Planning effort covered a total of 961,910 acres, of which 105,105 acres are private; 45,191 acres are State; and 811,613 acres are Federal.

Maybell-Great Divide MFP

The remainder of the Little Snake Resource Area is covered by the Maybell and Great Divide Units. Unit Resource Analyses have been completed, and the MFP is scheduled for completion in 1977. This MFP will make a determination of proposed MFP coal lease offerings.

The White River MFP

The White River MFP was started in July of 1974 and completed in June 1975. The planning effort covered parts of Rio Blanco, Moffat, and Garfield Counties, consituting 561,000 acres of private lands, 58,000 acres of State lands, and 1,506,000 acres of Federal surface acreage. Total Federal mineral estate within this MFP area is 1,806,619 acres.

Public Participation in the Study Region

The public was notified of the planning effort by the news media and by personal mailings; (over 800 groups, agencies and individuals were on the mailing list); and an open public meeting was held to explain the planning area and planning procedure. BLM requested their involvement and participation for input, comments, and remarks.

URA Step III Inventory Workshops were held to show the public and interest groups what information BLM had to obtain their input. These were held on a resource basis, but were open to anyone who wanted to attend. Special meetings were held with industry to obtain coal input.

Open meetings were held at the URA Step IV and MFP Step I completion stage, to allow the public and interest groups to review identified, opportunities and resource recommendations. Public input was included in final resource recommendations.

Public meetings were held in several areas listed hereafter to present the conflict analysis-multiple use alternatives, and the District Manager's recommendations. Public and interest groups comments and proposals were considered and incorporated into the District Manager's final recommendation, wherever possible.

URAs and MFPs are public documents available for public review in the Craig District Office, in the respective area offices, and in the Colorado State Office.

Public participation in the Williams Fork MFP follows:

1. Public Introduction Meeting, Craig, Colorado, September, 1973 -- 51 in attendance,

2. Wildlife Recreation Meeting (Workshop), Denver, Colorado, December 4, 1973 -- 17 in attendance; Craig, Colorado, December 6, 1973 -- 32 in attendance.

3. Range-Watershed Meeting (Workshop), Craig, Colorado, December 12, 1973 -- 18 in attendance,

4. Minerals Meeting (Workshop), Craig, Colorado, December 1973 -- 20 in attendance; Denver, Colorado, February 1974 -- Industry and other Federal agencies,

5. Recreation - Wildlife - Step I MFP Public Meeting, Craig, Colorado, March 8, 1974 -- 20 in attendance; Denver, Colorado, March 16, 1974 -- 20 in attendance,

6. MFP Step II and Proposed MFP Step III Public Meeting, Denver, Colorado, April 2, 1974 -- 25 in attendance; Hayden, Colorado, April 4, 1974 -- 39 in attendance.

The above summary shows a total of 242 people in attendance at public meetings. It should be noted that these numbers actually represent many more, based on the large membership of organizations for which representatives were in attendance, such as the Sierra Club, Audubon Society, Defenders of Wildlife, Wilderness Society, sportmens groups, recreation groups, and many other special interest groups, concerned individuals, County, State and other Federal agencies. Complete lists of attendees are on record.

A list of public meetings held in connection with BLM's planning efforts in the study region follows:

Williams Fork MFP

Description of Meeting Purpose	Date	Location
URA	September, 1973	Craig
URA	December, 1973	Denver
URA	December, 1973	Craig
URA	December, 1973	Craig
URA	December, 1973	Craig
URA	February, 1974	Denver
MFP	March, 1974	Craig
MFP	March, 1974	Denver
MFP	April, 1974	Denver
MFP	April, 1974	Hayden

White River MFP

URA	September, 1974	Denver
URA	September, 1974	Grand Junction
URA	September, 1974	Rifle
URA	September, 1974	Meeker
URA	November, 1974	Rangely
URA	November, 1974	Meeker
URA	November, 1974	Rangely
URA	November, 1974	Meeker
URA	November, 1974	Golden

Description of Meeting Purpose	Date	Location
URA	November, 1974	Englewood
URA	November, 1974	Boulder
URA	November, 1974	Englewood
URA	November, 1974	Meeker
URA	November, 1974	Rangely
URA	November, 1974	Meeker
URA	November, 1974	Rangely
MFP	May, 1975	Denver
MFP	May, 1975	Meeker

Great Divide/Maybell MFP

URA	January, 1976	Craig
URA	February, 1976	Craig

Process for Identification of MFP Coal Lease Tracts

A description of the tract identification process follows. These tracts were identified prior to the adoption of the final EMARS leasing regulations. Tract identification was based on a concept of the new leasing system at the time; therefore, the tracts identified are not formal selections for leasing, but rather are identified as areas of possible future Federal action. Prior to any formal tract selection in the study region, new information necessarily limited to EMARS nominations, competitive and preference right lease applications, data on coal occurrence and development potential from the USGS, and other non-coal resource development opportunities would have to be incorporated and used as a basis for site-specific environmental analysis of each identified EMARS lease offering. MFP recycling would be required before any EMARS nominations could be analyzed, pursuant to NEPA, as site-specific Departmental proposals for EMARS leasing.

Summaries of the identification of proposed MFP coal lease tracts for both the Williams Fork and White River MFPs follow.

Williams Fork MFP

URA - Step III: (Inventory of present situation)

A minerals inventory, including coal, was completed by a District Staff Minerals Specialist. Information was obtained from all available sources including BLM, USGS, Bureau of Mines, State Geological Survey, theses, publications, universities, and industry.

An analysis of existing mining operations was completed, and a summary of all available information on old and abandoned mines was compiled. Information on and from coal exploration plans and proposed mining plans was researched. With assistance from USGS, all information possible was obtained from oil and gas drilling logs and other mineral logs, where drilling occurred and logs were recorded.

From information obtained in the inventory, the specialist identified areas potentially suitable for surface mining and indicated underground operations.

From analysis of geology and other material, the unit was broken into: (1) Indicated Coal Areas, (2) Coal Resource Areas, and (3) Coal Development Areas.

URA Step III further identified existing coal leases, lease applications, active exploration permits, applications for exploration permits, coal withdrawals, State coal leases, and USGS known coal leasing areas (KCLAs).

URA - Step IV: (Opportunities for development)

Step IV projected information from Step III for opportunities and potential for coal development and production within the Unit. This step delineated mineral areas, and the factors and criteria utilized in forming the boundaries.

The Coal Development Area was broken down further into 1st and 2nd priority lease areas. Priority lease areas were calculated for measured and indicated coal reserves in short tons in-place down to 3,000 feet, with surface mining considered only on areas with less than 200 feet of overburden.

This step laid the groundwork for MFP tract identification. Close coordination was required at this point between BLM and USGS within the priority areas for eventual identification of logical mining units (LMUs).

MFP Step I: Resource recommendations

Specific tracts identification was made at this time; twenty tracts were so identified.

Seven site specific criteria were utilized to reinforce opportunities identified in URA Step 4: (1) Adjacent Development, (2) Industry Interest, (3) Outstanding Applications, (4) Strip, (5) Underground, (6) Topography, and (7) Existing Access and Utilities.

The twenty tracts were further broken down into six tracts identified for short-term leasing (with respect to time, such as 1st, or in the near future), and the remaining fourteen (14) tracts were identified for future leasing.

MFP Step II: Conflict analysis and multiple use recommendations

Conflicting resource recommendations were identified and analyzed by the Area Manager on identified tracts.

The multiple use alternative recommendation was to offer tracts one through six, and hold action of recommendation on any additional tracts.

MFP Step III: District Manager's recommendation

Recommendations and alternatives to conflicts were analyzed by the District Manager; he recommended leasing to the Colorado State Director for tracts 1 through 6 on a short-term basis, and tracts 7, 9 through 12, and 14 through 20, on a future-offer basis. It was his decision to drop tracts 8 and 13, due to conflicts with habitat for Greater Sandhill Cranes, a rare and endangered species of wildlife in Colorado.

These recommendations were forwarded to Colorado State Director for review and approval of the entire plan; plan was approved in June 1974 by Colorado State Director.

White River MFP

URA Steps III and IV were conducted in the same fashion as in the Williams Fork MFP.

Twelve tracts were initially identified by the Minerals Specialist in MFP Step I Conflict Resolution (MFP Step II). The District Manager's recommendation, (MFP Step III), resulted in a final recommendation to the State Director of two tracts identified for leasing: one near Rangely, and one near Meeker. The other ten lease tracts were to be included in a District-wide leasing priority system in any future Federal program. When additional tracts are required, alternate leasing between Rangely and Meeker would be practiced, to balance growth and development in Rio Blanco County.

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